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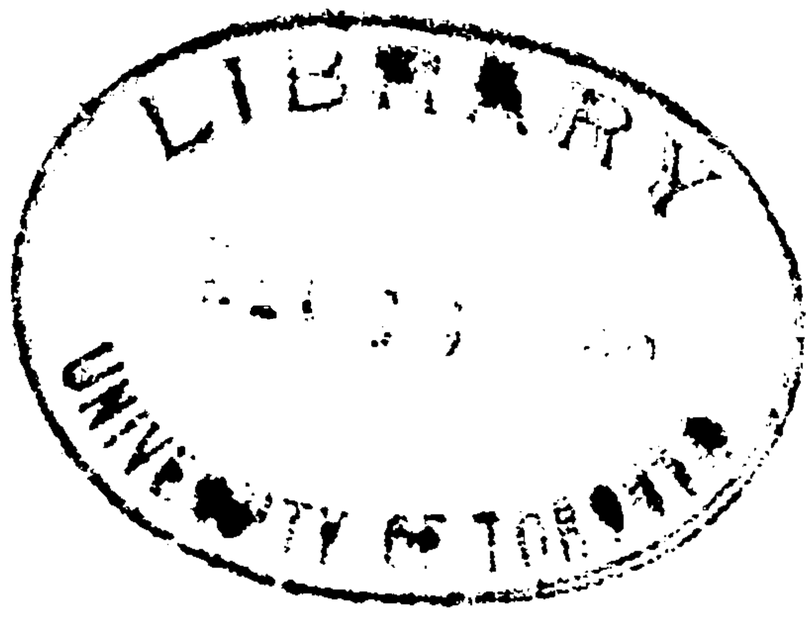
# VOLUME XII, 1922

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# THE GEOGRAPHICAL REVIEW

VOL. XII JANUARY, 1922 NO. 1


## THE HWANG HO, YELLOW RIVER

By FREDERICK G. CLAPP

From Kansu to Shantung the Hwang Ho is a dirty yellow. This color whence the river takes its name comes from the silt-like loess which it carries in suspension and which likewise gives name to the sea into which it flows. The river-borne loess is at once source of prosperity and of disaster. The alluvial plains of the Hwang Ho are of extraordinary fertility; but in its lower course the aggrading stream periodically breaks its banks, devastating the surrounding country and earning its well-known synonyms, "China's Sorrow," "The Ungovernable," and "Scourge of the Sons of Han." [1]

### HISTORICAL IMPORTANCE OF THE HWANG HO

In the basin of the great river, with its vast agricultural possibilities and its difficult problems of water control, Chinese civilization acquired its distinctive character. All accounts agree that this basin was the "cradle of the Chinese race." Whatever the origin of the race—and it seems most probable that they were a steppe people from the west—we find the Chinese at the dawn of history settled on the hill-sheltered plains of Shensi, whence they spread to the wide plains of the east, of Chihli and Shantung.[2] In the fertile plains are the ancient centers of religion and culture—from Sianfu (Singanfu), historic capital of the Wei Ho valley, to Tsinanfu at the foot of the holy mountain of Shantung. Among legends concerning the Hwang Ho is one that out of the river the original Chinese dragon brought to Fu-hi (whose reign is said to have commenced at Sianfu in B. C. 2852) the scroll on which were engraved "the eight permutations," or strokes from which the Chinese alphabet has developed.

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[1] L. Richard: Comprehensive Geography of the Chinese Empire, Shanghai, 1908, p. 28.

[2] For references to current theories on the subject see the next article, "The Geographical Factor in the Development of Chinese Civilization," by C. W. Bishop, p. 19. Special reference should be made to E. T. Williams: The Origins of the Chinese, *Amer. Journ. of Phys. Anthropol.*, Vol. 1, 1918, pp. 183–211.

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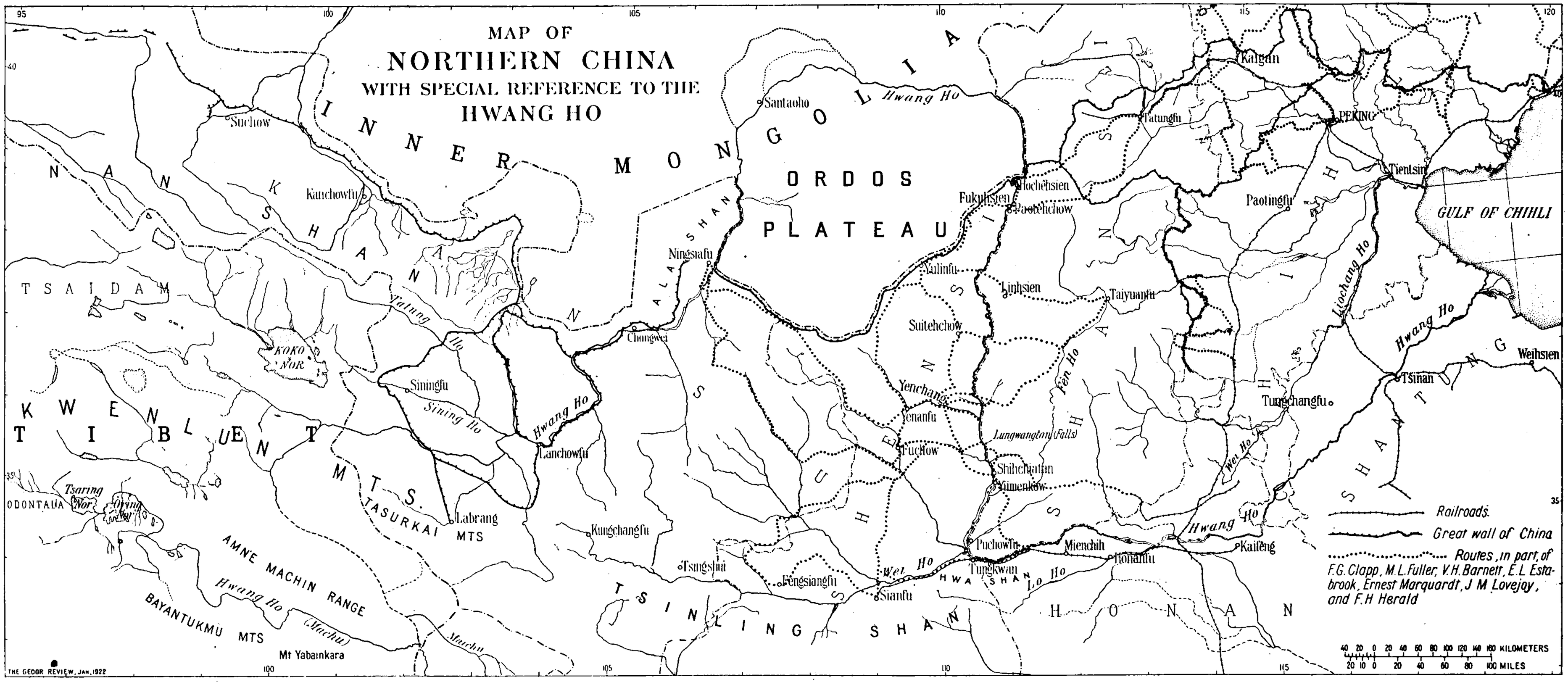


FIG. 1—Sketch map of the Hwang Ho. Approximate scale 1 : 11,000,000. The map is reduced from that of the Great Wall of China (scale 1 : 2,000,000), *Geographical Review*, Vol. 9, 1920, with additions to complete the course of the river, and with revisions of the routes followed by the author and his associates.

## Source and Upper Reaches of the Hwang Ho

The great river [3] rises in east-central Tibet about 60 miles west of Tsaka Nor (lake) or Tsaring Nor, south of the Kwenlun Mountains and of the Koko Nor region. The region was visited by Przhevalski in 1884, who says that the Yellow River "is formed at a height of 13,600 feet by two streamlets, flowing from the south and west, out of the mountains scattered about the plateau, and is fed by numerous springs of the wide marshy valley (40 miles by 13⅓ miles) known by the name of Odon-tala, known to the Chinese as *Sing-su-hai*, or starry sea."[4] Rockhill crossed the Odontala a few miles west of Tsaring Nor in 1889 entering from the Ts'aidam basin by the Bordza-kera pass, 15,650 feet elevation. In the valleys were many large bears, practically the only inhabitants. Rockhill tells us that every year in the seventh moon the source of the Hwang Ho was worshipped by the Chinese Emperor, who sent an official to sacrifice a white horse and seven or eight white sheep. The officials, however, are supposed usually to have pocketed their expense money and to have refrained from purchasing and making the animal sacrifice.[5] Tafel visited the region in 1906. He describes the main source of the river as lying in a depression at the western end of the Odontala about 100 kilometers west of Tsaring Nor, in latitude 35° N. and longitude 95° E., and at an elevation of 4,350 meters (14,270 feet). He credits Tsaring Nor with an elevation of 4,260 meters (13,975 feet) above sea level.[6] From the Tsaring Nor the Yellow River flows into the Khnora Nor, or Oring Nor, a few miles east. The eastern shore of this lake and a part of the upper course of the Yellow River were traversed and mapped by the Filchner expedition of 1903–1905.[7] Other tributaries of lakes Oring and Tsaring are said to bring more water into them than the stream commonly recognized as the source of the river.

The upper part of the Hwang Ho is called Soloma by the Mongols and Ma ch'u or Rma ch'u by the Tibetans, and it is also known as Alten Gol or Gold River. The old highway from Siningfu in western Kansu to Lhasa, the capital of Tibet, crosses the Hwang Ho only a few miles west of Tsaring Nor. From the lakes the river flows eastward for 200 miles and then bends northwestward, flowing in places in a broad valley where the stream itself is over 600 feet across.

In the year 1908 Vicomte d'Ollone, a major in the French army, traveled from Sungpan, in northwestern Szechwan, down the "Little Yellow River"

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[3] Certain parts of the course have never been traversed; hence the length of the river can only be estimated. Richard gives 2,700 miles, the figure given by the U. S. Geological Survey (*Press Bull. 478*, October, 1921); common school geographies give a length of 2,800 miles; the writer places it at 2,900; and Herrmann (Der Hwang-ho, *Zeitschr. der Gesell. für Erdkunde zu Berlin*, 1916, p. 86) apparently at 3,075 miles, that is only slightly less than the Yangtze.

[4] Letters from Colonel Prejevalsky, *Proc. Royal Geogr. Soc.*, Vol. 7, 1885, pp. 167–172; reference on p. 170.

[5] W. W. Rockhill: The Land of the Lamas, New York, 1891, pp. 170–173.

[6] Albert Tafel: Meine Tibetreise, 2 vols., Berlin, 1914; reference in Vol. 2, p. 20 and map.

[7] Wilhelm Filchner: Wissenschaftliche Ergebnisse der Expedition Filchner nach China und Tibet, 1903–1905, 11 vols., Berlin, 1906–14. A short account of the work of the expedition, with map, is given in *Deutsche Rundschau fur Geographie*, Vol. 37, 1914–15, pp. 521–526.

to where it meets the Yellow River near the apex of its great bend in eastern Tibet. That portion of the river was said not to have been previously explored. Although Ollone expressed his opinion that the source of the Hwang Ho is in the Amne Machin range of mountains, from 100 to 300 miles farther east than the ordinarily supposed source, no evidence seems to exist of the truth of this suggestion. Ollone's opinion was based on the fact the nomadic tribes living in the vicinity of the Amne Machin range call it the Anyei Machi.[8] He explains that "in their language *anyei* signifies 'ancestor', and *Machi* is their name for the Yellow River," hence, that the name of the mountain range would signify "ancestor of the Yellow River." According to Ollone "it is the universal belief that this range contains the principal springs of the river, which have hitherto been attributed to the lakes Nyoring-So and Doring-So."

The Yultao Hwang Ho, or Little Yellow River, reaches the Great Yellow River, which is rather more rapid, in the midst of a level plain; and the slower stream is repulsed so that the channel is almost checked by the detritus. Caravans composed of hundreds of yaks and fighting men with long gleaming lances come from the Tibetan desert regions every few months, crossing near the mouth of the Little Yellow River and proceeding thence to Sungpan (Songpanting) in northwestern Szechwan. They are composed largely of merchants of that place, who carry tea into the Koko Nor region and return with hides and pelts.

According to Ollone, who carried a theodolite, the tip of the great bend is about 60 miles farther east than it appears on maps published previous to 1912.[9] The Little Yellow River rises a few miles northwest of Sungpan and runs northwestward over 200 miles through a barren mountain region to its confluence with the Hwang Ho. The Tibetans call this principal tributary the Maichu and call the main river the Machu or Machi. It should be noted that Ollone does not place the mouth of the Little Yellow River on the tip of the great bend, but about halfway from there to the point where the Yellow River again bends northeast. The region of the Yultao Hwang Ho is thinly populated by the federation of Dzorgei, comprising wild tribes living by pillage as well as by cattle raising.

Occupying the great bend of the Hwang Ho and westward is the mountain mass now known as the Kwenlun, of which the Amne Machin range is the eastern end. South of this stretch of the river lie the Bayantukmu Mountains and Mt. Yabainkara.

Near the confluence of the two Yellow Rivers, hidden in a hollow of the mountains, stands the convent of Chaga Weisyong; and near the headwaters of the Tana Chu in the northern flanks of the Tasurkai Mountains is the celebrated lamasery of Labrang. The latter has hitherto been mentioned as the terminus of the southern branch of the Kansu loop of the Great Wall

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[8] Vicomte d'Ollone: In Forbidden China, transl. by Bernard Miall, London, 1912, p. 256.

[9] *Op. cit.*, p. 250. In *La Géographie*, Vol. 21, 1910, p. 438, Ollone gives the position of the most easterly point of the great bend as latitude 33° 34′ N. and longitude 102° 10′ E. (99° 50′ E. of Paris).

of China, but Ollone found the Great Wall continued as a lofty rampart, still guarded by an outpost of soldiers, about 100 miles farther south, only one day's journey north of Sungpan,[10] in the borders of Szechwan.

## The Hwang Ho in Kansu Province

The elevation of the Hwang Ho on the Tibet-Kansu boundary is given as 8,230 feet above the sea, and at Lanchowfu 5,100 feet.[11] About 70 miles east of the Kansu border it is crossed by the west limb of the so-called "Tibetan Loop" of the Great Wall of China.[12] It passes the city of Sünhwa a few miles farther on, and about the center of eastern Kansu it reaches Lanchowfu, at which point the "Tibetan Loop" joins the main Kansu loop of the Great Wall.

In this part of its course the Hwang receives from the west an important tributary, the Sining Ho, which, with its own tributary the Tatung Ho, rises in the Koko Nor region and enters the Hwang Ho about 40 miles above Lanchowfu. In the same region the Tao Ho enters from the south, flowing from the northern slopes of the Min Shan on the border of Tibet east of the great Tibetan loop of the Hwang.

The great city of Lanchow, the capital of Kansu Province, picturesquely surrounded by heights crowned with pagodas and built on both banks of the Yellow River, was crossed until recently by a bridge of boats over 600 feet in length, known in China as the "most beautiful bridge in the world." In 1909 it was replaced by a fine steel bridge whose construction was supervised by an American engineer, Robert Coltman 3rd. This is the only bridge over the river till that on the Peking-Hankow railroad is reached in the eastern maritime provinces. The bridge is crossed by a continuous stream of travelers, proceeding to and from the east and west along one of the greatest highways of the world (the old "silk road"). This great route connects Sianfu with the provinces of Sinkiang, western Mongolia, northern Tibet, western Siberia, and Turkestan. Along it the two-wheeled cart is the principal means of long-distance travel, but wheelbarrows are also common. Lanchowfu is the principal stopping place in Kansu for most of this traffic. The population, variously estimated at figures ranging from half a million to less than 100,000,[13] is largely Mohammedan, but one sees nearly all eastern religions represented. Ollone compares the mingling of peoples on the bridge thoroughfare with that on the bridge of the Golden Horn. The streets of Lanchowfu are narrow for the cities of northern China; but the houses are mostly well built, and the city walls and gate towers are in good repair. The chief industries are related to tobacco and fur brought

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[10] Ollone, *cit.*, p. 217.

[11] Albert Herrmann: Der HWang-ho. Versuch einer Monographie nach Filchners und Tafels Forschungen, *Zeitschr. der Gesell. für Erdkunde zu Berlin*, 1916, pp. 79–94; reference on p. 86.

[12] See the author's article "Along and Across the Great Wall of China," *Geogr. Rev.*, Vol. 9, 1920, pp. 221–249.

[13] R. S. Clark and A. de C. Sowerby (Through Shên-kan, London, 1912, p. 60) give 500,000; Tafel (*op. cit.*, Vol. 1, p. 151) compares the several estimates that have been made. He is of the opinion that the town numbers not more than 120,000 at the outside.

from the west; but gold, silver, and jade merchants and curio dealers were numerous in the days of the Empire.

The valley of this part of the river is fertile and intensively cultivated by irrigation. Water for the purpose is raised by means of wooden wheels with attached buckets placed in the current along the banks (compare Fig. 13, p. 35). The surrounding country, however, is dry and barren. The river at Lanchowfu is frozen over for one and a half months in the year.

Fifteen miles below Lanchowfu is the little village of Hsiaoshuitzu[14] perched on a rocky cliff on the south bank of Hwang. At that place the

FIG. 2—Gorge of the HWang Ho—narroWs in Sinian limestone—near Hochêhsien in northWestern Shansi. (Photograph by E. L. Estabrook.)

tortuous but swift river cuts deeply into granitic rocks and turns abruptly to pursue a general northeasterly direction.

Until Chungweihsien is reached the river flows through gorges, and its course is marked by rapids.[15] It is, however, navigated to some extent by rafts and boats, the former being the safer. Below Chungwei the Ordos is entered. In its stretch northeastward from Kansu through the Ordos the Hwang Ho flows mainly through desert, which has buried former cultivated plains and in places even the Great Wall. At Chungwei a new loop of the river has temporarily restored the fertility of the soil and supports a fairly large population. Some irrigation is done in such places, but long-buried cities exist in this region. The northern boundary of a portion of eastern Kansu follows the Hsi, Holan, or Ala Shan (mountains), which are bordered on the south for over 100 miles by the Hwang Ho. In this part of its course

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[14] Clark and Sowerby, *op. cit.*, p. 59.

[15] Eric Teichman: Routes in Kan-su, *Geogr. Journ.*, Vol. 48, 1916, pp. 473–479.

the river is deflected northward by the Ordos plateau. Throughout the greater portion of its course in Tibet and Kansu the Hwang appears to traverse mainly crystalline rocks, though at Ningsiafu on the border of the Ordos the stream is not far distant from the western border of the Carboniferous basin of eastern Kansu and Shensi. The river leaves Kansu Province at an elevation of about 3,300 feet above the sea.

On the line of the Great Wall, close to the Mongolia-Kansu-Shensi border is the important city of Ningsiafu in an oasis of considerable size. At Santaoho, somewhat more than 150 miles below here, Belgian Catholic

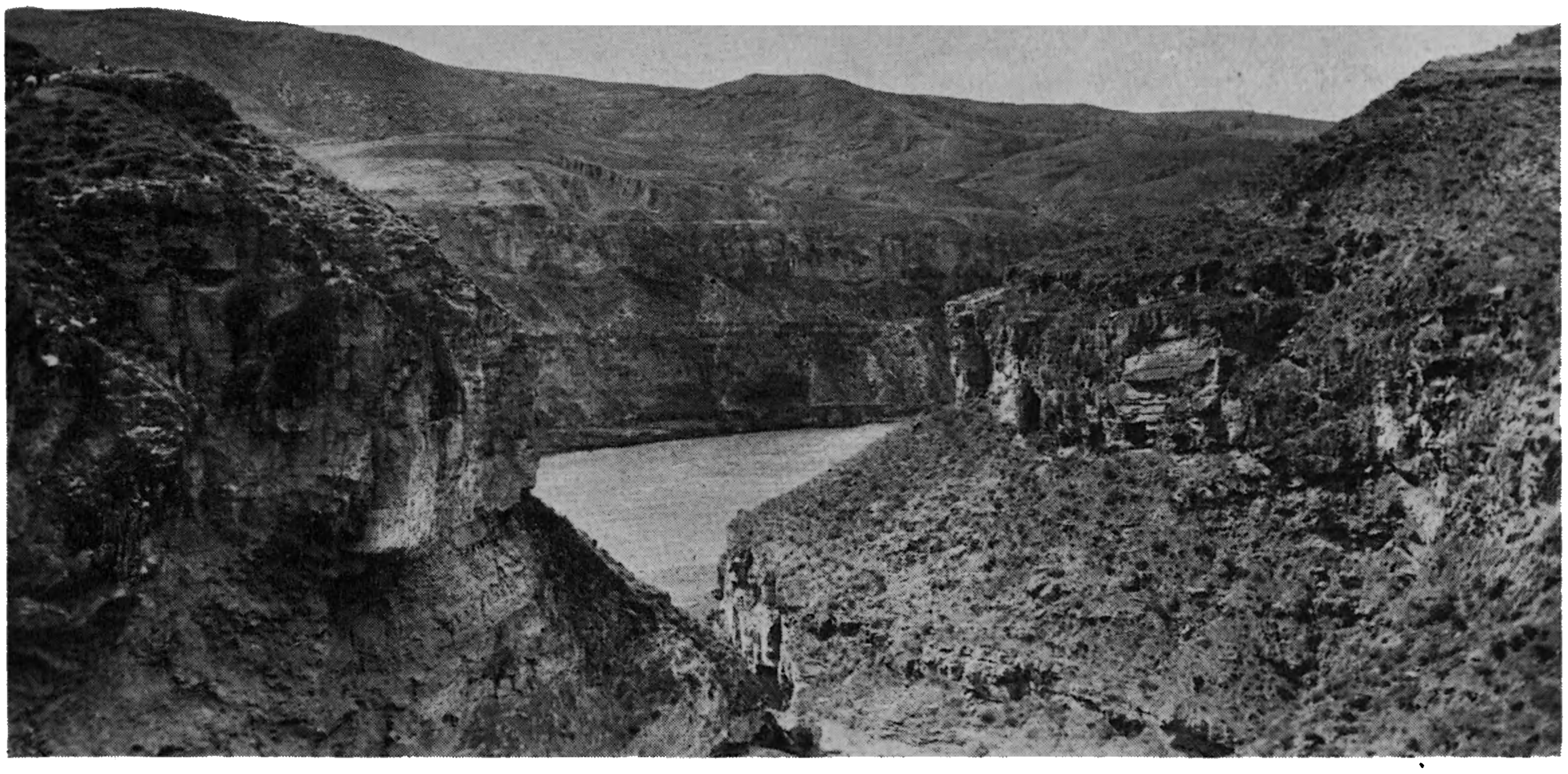

FIG. 3—One of the many picturesque glimpses of the Hwang Ho in the stretch between Shansi and Shensi. (Photograph by E. L. Estabrook.)

missionaries have introduced irrigation, planted trees, excavated irrigation canals, and redeemed a tract from the desert, so that a substantial Christian mission which was built up years ago includes some thirty villages. The "burgomaster" of that community is as much its ruler as is the Magistrate of most Chinese municipalities.

## THE HWANG HO IN MONGOLIA

About 150 miles north of Ningsiafu the river bends gradually eastward under the influence of the highlands comprising the Charanarin Ula or Lan Shan on the north. In this vicinity the Hwang has at various times had several ancient courses, which in one case differ from its present channel throughout a distance of over 180 miles, the middle point of which lies nearly 50 miles outside its present position.

The region comprised in this great bend of the Hwang Ho north of Shensi Province is known as the Ordos Desert, roughly circular and about 250

miles across. A part of the Desert of Gobi, it is one of the most barren regions of the world, although it once had a civilization whose existence is evidenced by buried cities and other instances of culture. Its sand dunes, quicksands, and barren hills are inexpressibly dreary and have been crossed by few travelers.

About 400 miles below Ningsiafu the river again bends southward, at the point where it strikes the Shansi boundary. Steamers sometimes descend the river as far as Hokow just within the boundary. Below Hokow navigation becomes difficult. In the autumn of 1914 S. H. McClure, working under

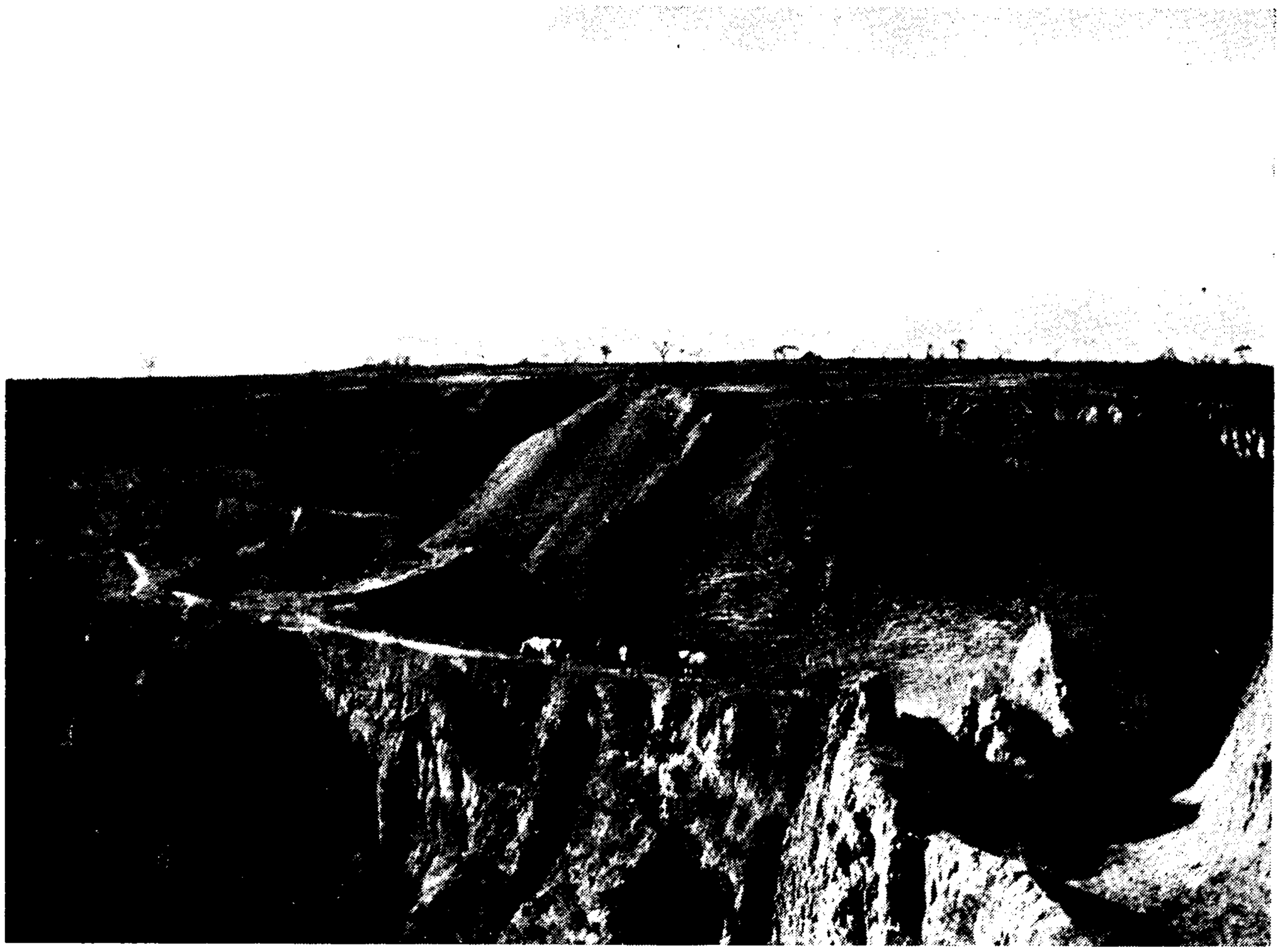

FIG. 4—A loess "bridge" near Yenchang, Shansi. Such features, which sometimes are true bridges, are common in the high plateau of Shensi. Usually they are only practicable for travel on foot or in the saddle.

the direction of the writer, made a hazardous trip by flatboat from Hokow 100 miles downstream to Hochêhsien, descending the dangerous rapids known as the "Dragon's Mouth." The river in places passes through miles of deep gorge and towering cliffs between which the waters rush and swirl.

The river crosses the Great Wall at Hochêhsien, a branch of the wall partly in ruins bordering the left bank of the river from 10 miles or more above this point to 15 or 20 miles below it. Ten miles above Hochêhsien the Hwang is intersected by a fault against the edge of Carboniferous coal-measure rocks, and the Sinian [16] (Cambro-Ordovician) rocks are thrown down to the north, forcing the river to bend abruptly west as far as Hochê-

[16] The term Sinian, introduced by Pumpelly to express a system of folds in eastern Asia, was applied by Richthofen to a limestone formation in northeastern China where these folds prevail. See J. S. Lee: An Outline of Chinese Geology, *Gecl. Mag.*, Vol. 58, 1921, pp. 259–265, 324–329, 370–377, and 409–420; reference on p. 328.

hsien where it again turns south. The river appears to be about 3,000 feet above sea level, and the high rolling hills reach to about 4,300 feet. From here southward the Hwang Ho crosses sediments of Carboniferous age, though for the major part of its Shensi-Shansi course the river is not far from the contact of the Carboniferous with the hard Sinian limestone which rises in the high mountain ranges to the east.

It may be noted here that in northern Shensi, some miles west of Fukuhsien, deposits of volcanic tuff and agglomerate indicate the existence of a former vulcanism in that general section of the country. The enormous

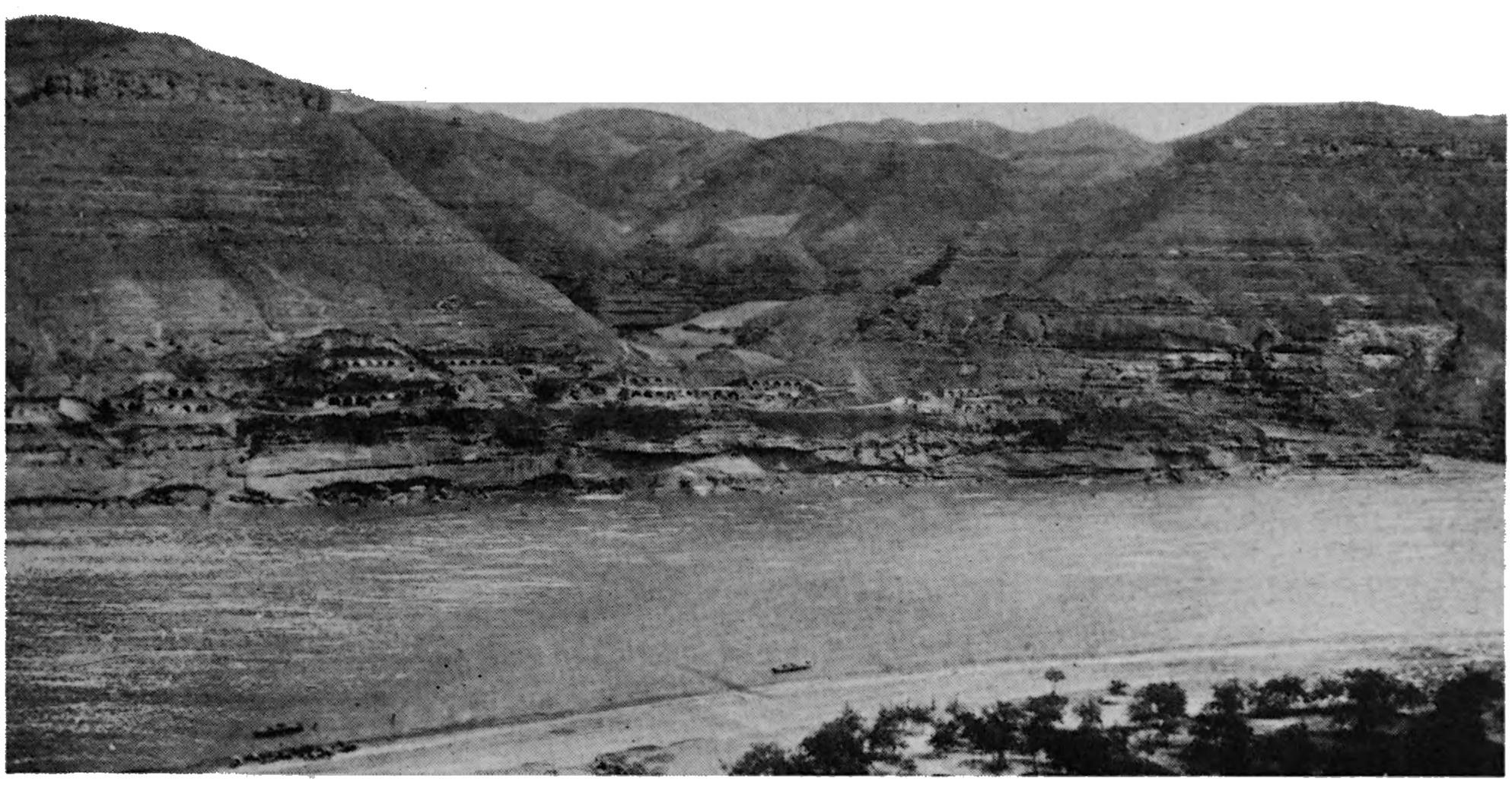

FIG. 5—Chingshuikwan, Shensi, from the Shansi shore. Chingshuikwan lies at the foot of a typically rough loess trail one day's journey northeast of Yenchang.

"volcanic bombs" found in the agglomerate stratum suggest the former existence of a great volcano.

## THE SHENSI-SHANSI PORTION OF THE RIVER

Thirty or thirty-five miles below Hochêhsien are Paotehchow, an important walled and turreted city on the Shansi bank of the river, and Fukuhsien, a similar city on the Shensi side. The party accompanying the writer and Edward L. Estabrook first visited Paotehchow, subsequently ferrying across to the other side. Both cities impress one as being much more prosperous than places visited farther east in spite of the difficulties of the trails. These are very great.

In their geology, topography, and industries the adjoining portions of Shansi and Shensi closely recall portions of Pennsylvania and West Virginia.

The hilly character of the trails, for instance, is a reminder of similar roads in West Virginia. From an altitude of 4,500 feet above the sea at the summit of Chienhungai Liang, eight miles east of Paotehchow, one descends to less than 3,000 feet at the river level, crossing a region of deep valleys on the sides of which are exposed coal-bearing Carboniferous rocks, standing out in sharp contrast from the overlying loess. The mines are operated by natives after their own primitive methods, and long lines of mules laden with great "run-of-the-mine" lumps may be seen starting to transport the coal eastwards. Here and there in the valleys stand numbers of brick and tile kilns and pottery works. The section closely resembles the deep ravines in the vicinity of Pittsburgh; one almost expects to see modern coke ovens or the chimneys of Homestead pouring forth their smoke. Nevertheless the air is clear.

The loess country of Shansi and Shensi is one of the roughest and strangest in the world.[17] In all the approaches of the writer's parties to the river or its side valleys, hundreds of feet were climbed in loess. When wet the loess is as slippery as the most argillaceous clay, so that the steep grades of the trails are then impassable. Most of the loess trails leading out of the valleys have grades of over 25 degrees. During wet weather it is impossible to reach the plateau.

With its coal mines and ferries and the pottery business Paotehchow is destined to become an ever more important place than it now is. The people are not antagonistic to strangers but have the ever-present curiosity of the Chinese concerning anything new or foreign. The existence of a small but comfortable inn enabled the writer's party to decline a cordial invitation from the Magistrate to stop in his *yamên*, and in front of the inn the populace celebrated the visit of Americans by setting off firecrackers both night and morning. The quarters proved to be the most comfortable between Peking and Yülinfu. An excellent Chinese dinner given by the civil and military officials and principal Chinese merchants proved a pleasant event.

At a point lower down on the river, at Hwanghoyeh, the Clark-Sowerby expedition crossed going west in the autumn of 1908.[18] The altitude was estimated as 2,400 feet above the sea, and 3,000 feet below the pass 20 miles distant on the highway to Linhsien in Shansi. The average height of the range between the Hwang Ho on the west and the Fên Ho on the east is 7,000 to 8,000 feet; but some crystalline peaks, like Mo-êrh Shan, rise much higher.

Below Paotehchow the next place at which the river was seen by a party under the direction of the writer was about 80 miles lower down, at Machia-tun on the Shansi bank, 35 miles northwest of Linhsien. A crossing here was made by the late V. H. Barnett.

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[17] The Writer has given a short account of the loess in his article "Along and Across the Great Wall of China," *Geogr. Rev.*, Vol. 9, 1920, p. 228.

[18] Clark and Sowerby, *op. cit.*, p. 14.

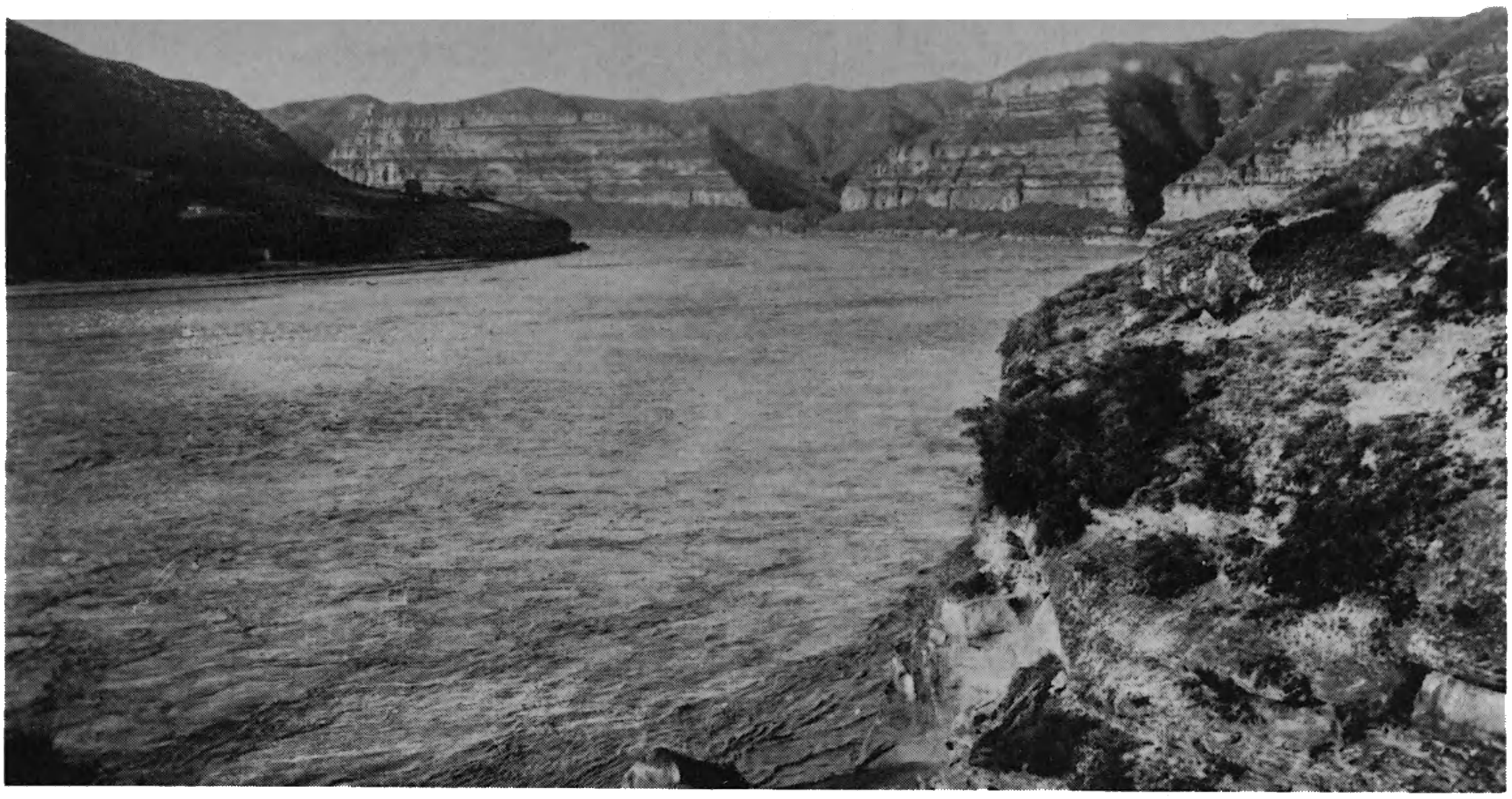

FIG. 6

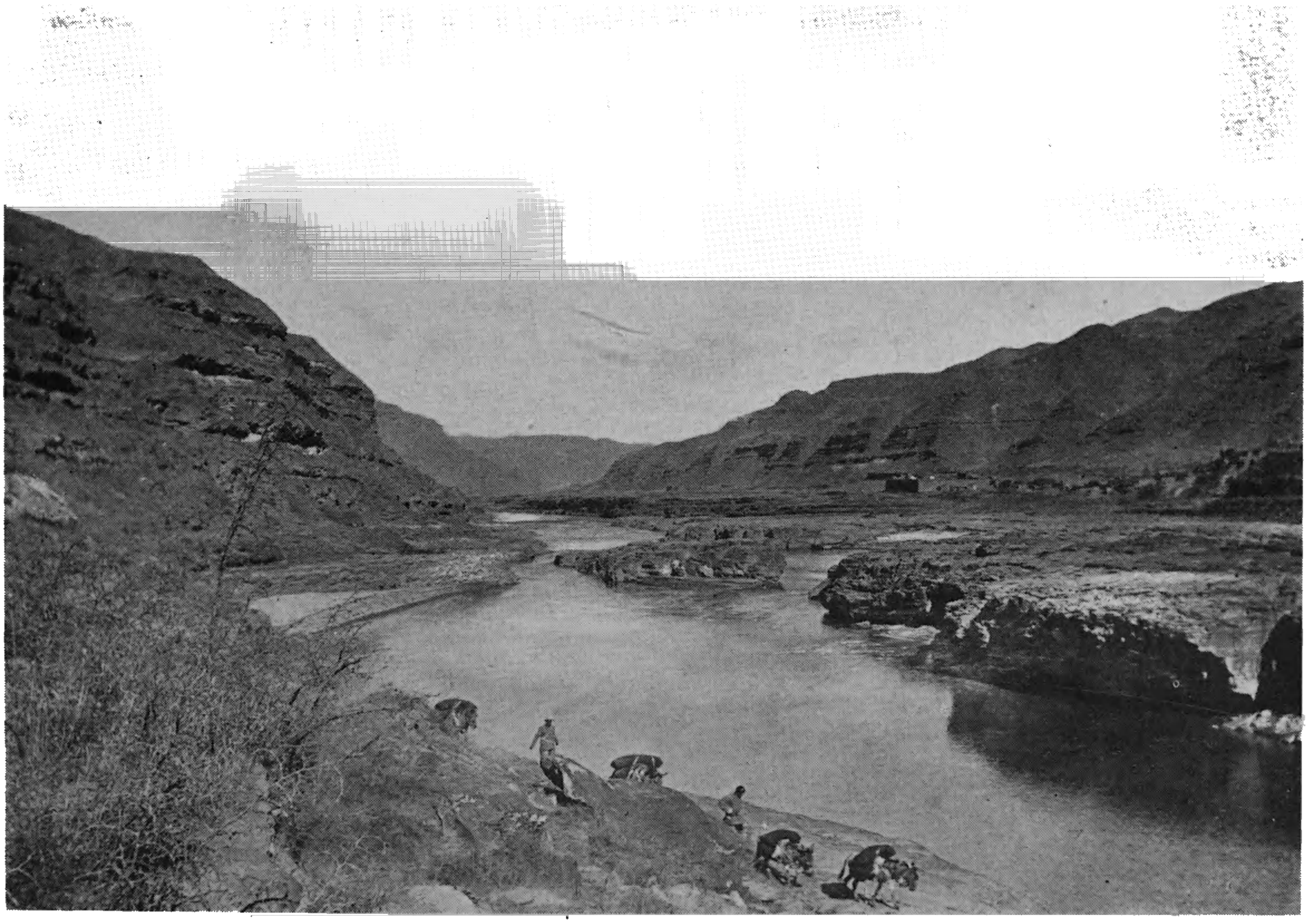

FIG. 7

FIG. 6—The Hwang Ho looking doWnstream from Chingshuikwan.

FIG. 7—-The HWang Ho looking upstream from a point between Kochent'an and the falls of Lungwangchan. Old fortifications are seen on the Shansi shore.

Farther down the Hwang Ho was approached at Chingshuikwan. To reach it we crossed shaky loess or sandstone cliffs which had been undermined by water, traveled on roadways hardly two feet wide with canyons 100 feet deep on both sides and frequently having yawning pits close beside them several feet in diameter and apparently bottomless.

The similarity of this part of the Hwang Ho canyon with that of the Colorado is not mere fancy, for here the great valley abounds with mesas as does that of the Colorado, and strata of sandstone and shale are piled a thousand feet one upon another up to the loess which rises hundreds of feet higher to the plateau level, making a picture long to be remembered.

The Hwang Ho is only an eighth of a mile wide at Chingshuikwan, so that one can almost speak across it; but, when the writer's party wished to cross the ferrymen steadfastly refused for three days to enter the boats, declaring the current too rough for safety. We could now appreciate the reply of the Magistrate of Yenchanghsien in Shensi who, a few days previously, on being asked what could be done to help the city, had responded, "Build a bridge over the Hwang Ho." The single available ferryboat was small and leaky, accommodating only thirteen men and three animals by crowding; and with this load the party finally succeeded in reaching the Shansi shore.

The climb from the river level was up 1,700 feet over rock and loess hills bounded by deep canyons, across which distant views of mountain and valley were at times secured. Finally, 3,600 feet above the stream, the party stopped for the night in a cave village underlying a wheat and vegetable field on the loess plateau. Within a few score of miles this portion of the Hwang Ho has been crossed by several of the writer's parties, including those of John M. Lovejoy and Edward L. Estabrook. Crossings here were also made by Myron L. Fuller, associated with the writer in the explorations in China.

The vicinity of Shihchiat'an, still farther down the river, is quite different in aspect from the country around Chingshuikwan. Instead of living in caves the people have substantial houses, and the narrow stretches of flood plain contain frequent small farms. A short distance below Shihchiat'an are coal mines which give rise to various industries. The river is navigable from near there to a point in the province of Honan, and numerous boats can be seen floating down or being "tracked" upstream.

A highway along the Shansi side of the river near Shihchiat'an was built at the time of the Taiping Rebellion and was then probably a good road; but it is now in such bad repair as to be barely passable for horses. Along six miles or more of it, paralleling the Hwang Ho, the ruins of a massive stone wall built at that time can still be seen. It is six to eight feet high and two feet or more in thickness, with numerous portholes, and must have proved an effectual barrier to attacks from the river or from the Shensi shore.

## Land and Water Transportation

The entire portion of the Hwang Ho between Shensi and Shansi is inaccessible by cart or by any form of vehicular travel, and the mountain trails are perhaps the roughest in the world. A cart road from the north touches the river at Potow in Mongolia and another at Hokow, about 100 miles apart on the northeastern portion of the Ordos loop. The former road extends northeast through Mongolia, the latter eastward in Shansi Province to Fengchen and Tatungfu. Both highways make connection with river shipment.

Traveling on the middle stretch of the river is said to average three to four miles an hour. At Laolungkow, in the stretch between Hokow and Paotehchow, is a very dangerous rapid caused by a single large rock in the river. Although from 500 to 1,000 boats descend this rapid every year, the loss is said to be less than one per cent, or about three or four boats a year. The river is open to navigation at Hokow about the first of April, is generally closed during July and August on account of heavy rains, and is again passable in September, October, and November.

In a few places where the water is low the cargo must be unloaded and reloaded. The boats seldom if ever return north but are sold at their southern destination. Some of the larger boats are said to carry as much as 30,000 pounds on a trip. The boats are commonly guided through the dangerous spots by experienced local pilots, and the Chinese boatmen are accustomed to burn incense when passing through the "Dragon's Mouth."

## The Great Falls

A few miles above Shihchiat'an on the Shensi shore is Kochent'an in the district of Yichuan. This part of the Yellow River, visited by the writer in March, 1914, is one of its wildest sections. The gorge consists of a deep canyon, and in order to reach the river level the party was obliged to descend 1,500 feet from the loess plateau. In one place, on a tributary of the Hwang Ho, is a rock cliff over 100 feet in height over which a cascade plunges in the rainy season, and for miles the river is walled by much higher cliffs.

The "ferry" on which the river is crossed is situated directly below a constricted portion, where the waters are concentrated and plunge madly over some dangerous rapids. Although stories had been heard of the "rapids" at Lungwangchan, four miles above this ferry, no one present was prepared for the magnificent cataract found there. Strange to say, it is scarcely mentioned in Chinese books available to the interpreters. It was, however, visited by Tafel in 1905 and has been described by him.[19] At a distance of many miles the clouds of spray resembled white smoke rising from a spot in the river valley. To this finally the military escort pointed and cried "Lungwangchan." At a distance of a quarter of a mile, moisture begins to blow in one's face, rendering photography difficult.

[19] Tafel, *op. cit.*, Vol. 1, pp. 61–62 and Pls. 17, 18, and 19.

The river is swift at Kochent'an and more so throughout the four miles upstream between that village and Lungwangchan, where the entire river, narrowing from a breadth of perhaps 1,000 feet, plunges into a deep gorge scarcely over 100 feet across, with a roar that rivals Niagara. The vertical drop is little over 50 feet at any one place in the river bed, but the stream descends 200 feet within five miles. As the entire volume of the Hwang Ho pours over the falls, it makes up for any lack of height.

On witnessing the falls one is at first inclined to discredit the story that boats descend the Hwang Ho from Mongolia to Honan. While standing on the brink of the canyon a mile or more below the falls, however, the writer heard a wild yelling in unison from across the valley, and over the sandstone terrace came a line of forty to fifty men, moving slowly southward as if with difficulty. Behind them, at the end of a stout cable, was being dragged a boat with its load of freight. Later other groups of men were seen dragging similar boats. Thus the inhabitants of Lungwangchan derive their living.

Between Lungwangchan and Yumenkow farther down stream are two other rapids, in which boats are sometimes lost. One is at Taoerwo, 20 miles south of the same place. Below Yumenkow the river is easily navigable to Sanmen, 17 miles northwest of Mienchih in Honan, where a great rock partially obstructs the river. The currents are said to flow towards this rock from three directions, and on it appear Chinese characters signifying "Come to me," or "Sail in my direction." By this scheme the navigator is induced to head his boat in the direction of the rock, and then the current carries him safely round it. If, however, the boatman expends his energy in trying to sail round the rock, it is said he will certainly strike it and be destroyed. Opposite Mienchih is a port named Mengchienhsien connecting it by a good cart road.

The principal tributaries of the Hwang-Ho in its Shansi-Shensi stretch are the Fên Ho from the east and the Wei Ho from the west, the former being estimated as 500 miles in length and the latter at least 400 miles. The Wei Ho heads only a few miles from the source of the Tao Ho, a large tributary of the Hwang Ho south of Lanchowfu. Several other tributaries on the Shensi side are over 100 miles long.

A few legends have come to us of the early history of Shensi, which are of interest concerning the Hwang. For instance in B. C. 2297 the "prosperity of the nation," one book states,[20] was disturbed by a "thirteen-years flood." Some think that this was the Biblical flood, but accounts indicate that it was of local character. It seems to have covered the entire valley of the Hwang Ho and part of that of the Wei. Emperor Yau ordered various officials to subdue the waters, for failing to do which they were executed. However, a man of the name of Yu, who afterwards became "Yu the Great," tried for eight years to accomplish the task and finally succeeded in carrying off the water by deepening the channels. He is said to have evolved his scheme

[20] Li Ung Bing: Outlines of Chinese History, Shanghai, 1914, p. 6.

of drainage by studying the marks on a turtle's back. So the Chinese have a saying, which has come down to the present day, that "we should have been fish but for Yu."

## Incidents on Route

Northern Shensi is scantily settled, and in the Ordos Desert few houses were seen, while Messrs. Fuller and Barnett who visited northwestern Shensi found they could travel all day without seeing a house. Generally, however, small villages exist every few miles, with such names as "Sanchia" (three families), "Shihlipu" (ten li shop), "Pachiats'un" (eight family

FIG. 8—Lungwangchan, the "Great Falls of the HWang Ho," in the lower portion of the Shensi-Shansi course of the river. The falls are impressive because of the volume of water carried and the great constriction of the river bed.

village), and other equally attractive designations. Most of these places are merely cave villages—unimpressive and sometimes most forbidding to the weary traveler who is looking for a good stopping place. Yet they are dry and comfortable inside, and an entire caravan manages to be accommodated even at places like "Sanchia," "Fanti," or "Tuenchiao."

The police of Chinese cities are of many contrasts as to appearance and efficiency. Some are dressed in clean, new uniforms, carry effective rifles, and would be recognized at once as members of an efficient police force, while others wear ragged clothing and have guns which appear to be half a century old. The Magistrates, or chief governing officials, vie with each other in efforts to provide proper protection to a traveler, every Magistrate furnishing at least as large an escort as the preceding one on the route

traveled and so properly passing on the expedition to the next *hsien* or district city. On the journey from Fukuhsien west to Yülinfu, the prevalent custom of furnishing large escorts resulted in great enthusiasm along the route, so that before reaching Yülinfu the travelers were being greeted daily by music and receptions, all of which is evidence of recent lack of travel from eastern China in this distant region.

On the highway running east and west through Sianfu restaurants and native "quick lunch" rooms are abundant. A sample dinner en route may be mentioned. Among the delicacies served were *chi-tz'erh*, *chao* (eggs, scrambled), *wan-tze* (meat balls), *yo pien* (chopped pork), *chi pien* (chopped chicken), *shon lui pai tsai* (Chinese cabbage with vinegar), *lao bing* (griddle cakes), *fan* (rice), and *cha* (tea). The total cost to geologist and interpreter was 786 cash, or about 25 cents in American money, and enough food was left over to furnish the waiter with a meal for himself.

## The River at Tungkwanting

At the great bend of the Hwang, a few miles below the mouth of the Wei Ho, is situated the city of Tungkwan. The valley begins to narrow here, and the city walls occupy the entire space between river and hills, thereby exercising full military control over the main highway from Honan Province along which all traffic must pass to approach Sianfu, the capital of Shensi. Tungkwan lies in Shensi but so close to the borders of Shansi and Honan that it may be said to constitute the key to three provinces. Its great stone citadel has only one approach, and it is high on the hills and well protected, while the business section lies below.

For thousands of years the battlements of Tungkwan have guarded the road to Shensi, and it is one of the few places that Jenghis Khan could never storm. In his first campaign for the conquest of China that great general sent an army to take Kaifêngfu. Reaching the river opposite Tungkwan, the army decided to avoid the place and started on a detour through the mountains of southern Shensi, in which it encountered such great hardships that it was defeated and driven back across the Hwang Ho into Shansi province to the north.

At Tungkwan is a ferry which is well traveled by the natives, being one of the great ferries of China. It is one in which sails are sometimes used instead of oars, although poles are also of value in crossing during low-water stages.

At three days' journey east of Tungkwan was seen what is reported to be the "oldest tree in China," not living but encased in a brick wall. There appears good evidence that it is as old as the beginning of the Chou Dynasty, about 3,000 years ago. The tree appears to be a cypress and is a dead trunk 40 feet in height. The base is encased in a mortared brick wall, surrounded by tablets, several of which are so ancient as to be illegible. One bears the inscription "Ancient Kan-tang," another says "Kindness of Chou Kung."

The story is that a man of that name came from the West some 3,000 years ago and stopped under this tree to preach the "doctrines of civilization." He was so kind that the inhabitants ever afterwards kept the tree intact in his memory, and the duty of its protection was passed down from generation to generation.

## Origin of the Shensi-Ordos Loop

Certain fundamental factors lead us to suppose the Hwang Ho has not always flowed as it does now. Leaving out of account historical floods as being too recent to have permitted the later development of any great valley, there are certain evidences that the portion of the Hwang Ho between Shansi and Shensi dates only from Quaternary time. Coming from the sizable valley with moderate gradient which extends from Lanchowfu and Hokow, the river restricts itself for 550 miles as far as Tungkwan between valley walls less than a mile apart rising semi-vertically in rock and overlying steep loess slopes to 1,000 or 1,500 feet above the river, quite different from the topography in other parts of the river's course. Although near Hochê-hsien the river passes through Sinian limestone for some miles, the rest of its southward course is excavated canyon-like in rock of Carboniferous age. This valley does not appear older than many Pleistocene or late Pliocene valleys in America and Europe. Moreover, there are, at Lungwangchan and several other points, rapids and falls entirely incommensurate in age with the Mongolian section of the river. It seems clear that the Shensi-Shansi portion of the river is younger geologically.[21] The fault at the base of the Hwa Shan range south of Tungkwan appears to be a continuation of the great Wei Ho fault. The Wei Ho valley, trending west of Tungkwan in direct continuation of the Honan course of the Hwang Ho, has a breadth of over 50 miles, a flat floor, a navigable river, and a great population. This valley heads only some 50 miles south of Lanchowfu—a fact which suggests that it may once have served as a basin for the Hwang Ho itself. In order to obtain a correct idea of the geography of this great river system, however, and of the causes of changes in its course, one would be obliged to examine the divides back from the source of the Wei.

Another region that deserves study from a similar angle is that east of Potow on the Ordos loop. If ancient valleys should be found there they would shed light on the problem. We can hardly doubt that the present Hwang River is a composite one; but further study is necessary to give definite answers to all of the questions that may be raised.

## Lowland Portion of the Hwang

The lowland portion of the river may be considered to be that part east of the pass of Tungkwan, where it deviates from its previous southward

[21] On interpretation of youthful character of the Hwang Ho in its Shensi-Shansi course see "Research in China," 3 vols. and atlas, *Carnegie Instn. Publ. No. 54;* reference in Vol. 1, Part I, pp. 234–236. See also J. S. Lee, article cited in footnote 16, pp. 419–420.

course and flows nearly east to a point about 25 miles below Kaifêngfu, where it bends northeast towards the Gulf of Chihli.

Near Hwaikingfu the river passes out of its gorges and reaches the great plain of Honan and Chihli, on which it is locally navigable. In the vicinity of Takouchên the writer traveled over many miles of rich agricultural country, mainly planted with winter wheat, dotted with long lines of prosperous villages. There are also miles of great bamboo thickets, in which the trees tower high above the traveler and in the vicinity of which the chief industry is the manufacture of bamboo goods. Adjoining this great plain the rough limestone mountains of Shansi rise abruptly 2,500 feet in height, and the main road over them is paved for miles with great blocks of limestone. Fine views of the Hwang Ho can be gained from the summits.

Where the Peking-Hankow Railroad crosses the Hwang Ho the river consists of a channel or series of channels aggregating one or two miles in breadth. The water is shallow, and the channels are continually shifting. This part of the river, according to unpublished notes of Myron L. Fuller, is navigable to small boats drawing a foot or a foot and a half of water and carrying perhaps three tons of freight. The clearance at the railroad bridge runs from 10 feet at low water to less than half that at high water.

## Changes in the River's Lower Course

Crossing great flood plains in its lower stretches the Hwang Ho has frequently changed its course in past ages. It has flowed alternately north and south of the mountains in Shantung Province, reaching the sea at points as much as 250 miles apart in an air line.[22] Its last important change was in 1851 previous to which time it left the present channel at the sharp bend east of Kaifêngfu, flowed southeastward through northern Honan and Kiangsu, and reached the sea only 130 miles from the mouth of the Yangtze Kiang. The Grand Canal followed the course of the Hwang Ho from Sutsien to Hwaianfu, a distance of about 60 miles. In the year 1851 the dikes gave way east of Kaifêngfu, and for two years the course varied considerably; but finally the Hwang embedded itself in the Tsi Ho, which had previously been of little importance. Another flood, which occurred in 1877, inundated an immense region and caused the death of millions of people and in 1898 was still another great flood. (See insert map, Fig. 1, p. 21.)

It is in the lower portion of the river that floods are now frequent and most dreaded. The flood phenomena consist in the bringing down of great quantities of mud from higher regions and the continual raising of the river bed which now stands many feet above the surrounding country. For instance where the Hwang crosses the Grand Canal in Shantung Province the river is said to be 16 feet above the canal level. On account of frequent floods no important city is built on the river banks in its lower course.

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[22] See the maps, Pls. 4 and 5, in Raphael Pumpelly: Geological Researches in China, Mongolia, and Japan, *Smithsonian Contributions to Knowledge, No. 202*, Vol. 15, Art. 4, Washington, D. C., 1866; and Jakob Menauer: Die Laufanderungen des Gelben Flusses in historischer Zeit, Nuremberg, 1912.

# THE GEOGRAPHICAL FACTOR IN THE DEVELOPMENT OF CHINESE CIVILIZATION

By CARL WHITING BISHOP
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The outstanding difficulty in the way of any real settlement of the Far Eastern Question is undoubtedly the lack of a spirit of nationalism on the part of the Chinese people. But for this lack, indeed, there could hardly be any Far Eastern Question at all. The problems now clamoring for solution in southeastern Asia have arisen just because China is thus disunited and decentralized and therefore incapable of developing her own resources and determining her own policies without fear of foreign interference. If, as is unfortunately true, the control of her destinies is no longer in her own hands, it is because neither the staid and conservative North nor the alert and progressive South has been able to secure the unreserved allegiance of her entire population.

## THE DISUNITY OF NORTH AND SOUTH

The spokesmen of the two sections declare, no doubt sincerely, that the point at issue is one of Constitutional interpretation; let that be settled, they tell us, and all will be well. Others, largely foreign observers these, would have us believe that the inability of Peking and Canton to discover any mutually acceptable basis for a real and permanent union is due to the different degree in which modern Occidental civilization has penetrated the two sections of the country. The South, say they, has been exposed for a longer period than the North to the influence of Western ideas. Both these explanations are doubtless true—in a measure. But that measure is not a large one.

There have been periods when China was great in the finest sense of that much misused word; when she was revered as a protector and teacher by her neighbors and respected as an equal, if not indeed as in some sort a superior, by the peoples of the West with whom she came in contact. But such periods have invariably been those when she was under the sway of a powerful dynasty able to compel the allegiance of all sections of the country. The moment the Imperial power has ebbed, ancient political and cultural and even ethnic antagonisms have emerged to view; latent tendencies toward separatism have become active; and local governments, each usually claiming *de jure* control over the whole people, have set themselves up in various sections of the country. The four hundred years of anarchy and general disruption which followed the downfall of the great House of Han, early in the third century of the Christian era, and that briefer interval,

during the tenth, known as the period of the Five Short Dynasties, offer us repeated examples of the same tendency that is operating before our eyes. And invariably the main lines of social and political and economic cleavage have run east and west, save in a few partial instances for which local and temporary conditions have been responsible.

In view of the persistence of this phenomenon despite the very real homogeneity of Chinese civilization for several centuries past, it seems clear that there must be some fundamental cause which has been operating for ages and whose unfailing tendency has been to divide the country into northern and southern sections the moment that the central authority, whether feudal monarchy or bureaucratic empire or constitutional republic, loses its grip. Such a cause, so constant in its operation and so unvarying in its effects, could scarcely be other than a physical one.

There can be little doubt, indeed, that this cultural and at times political division of China into a north and a south has been due primarily and fundamentally to the way in which the introduction and diffusion of civilizing influences from the earliest prehistoric times downward have been determined by her rivers.

Of these there are four principal groups. In the north is that including the lower Hwang Ho[1] and a few minor streams occupying what is generally known as the North China plain. South of this is the Yangtze system, separated from the preceding by that Tsingling range of mountains which with its lower eastward extension has always formed the real boundary between northern and southern China.[2] Along the coast, below the mouth of the Yangtze, the third group is composed of numerous streams, large and small, forming independent systems of their own. Lastly on the extreme west the Salween and the Mekong, though scarcely Chinese rivers in any true sense at all, still flow through Chinese territory for a certain portion of their course.

## The Dawn of Civilization in China

It was in the valley of the Hwang Ho that civilization first made its appearance, some time, according to the best evidence available, between 3000 and 2500 B. C.[3] It was essentially of a Bronze Age type, not pastoral and nomadic but settled and agricultural,[4] with its fundamental features derived from the same common source with those of the great historic

[1] Save where usage has rendered other forms more familiar to the English reader, the transliteration of Chinese names in this paper follows Giles's dictionary.

[2] See regarding this function of the Tsingling range, L. Richard's Comprehensive Geography of the Chinese Empire and Dependencies, Shanghai, 1908, p. 42; Bailey Willis, *Bull. Amer. Geogr. Soc.*, Vol. 38, 1906, pp. 413 and 423.

[3] Dr. E. T. Williams has ably summed up the evidence for this in his paper, "The Origins of the Chinese," *Amer. Journ. of Phys. Anthropol.*, Vol. 1, 1918, pp. 183–211.

[4] Dr. James Legge (Shu King, "Chinese Classics," p. 191) says "The Chinese could never have been a tribe of shepherds." Shên-nung, the patron divinity of agriculture (Rev. John Ross: The Origin of the Chinese People, Edinburgh and London, 1916, p. 5) and the subject of some very early myths, is represented with the head of an ox ( Henri Doré: Recherches sur les superstitions en Chine, Shanghai, 1911, Vol. 10, p. 717) and most probably stands for an original ox or bull god of fertility, so common among agricultural peoples throughout the Eurasiatic culture area. The fact that Shên-nung is represented as having been sired by a dragon, the fertilizing agent *par excellence* in both ancient and modern China, suggests this also.

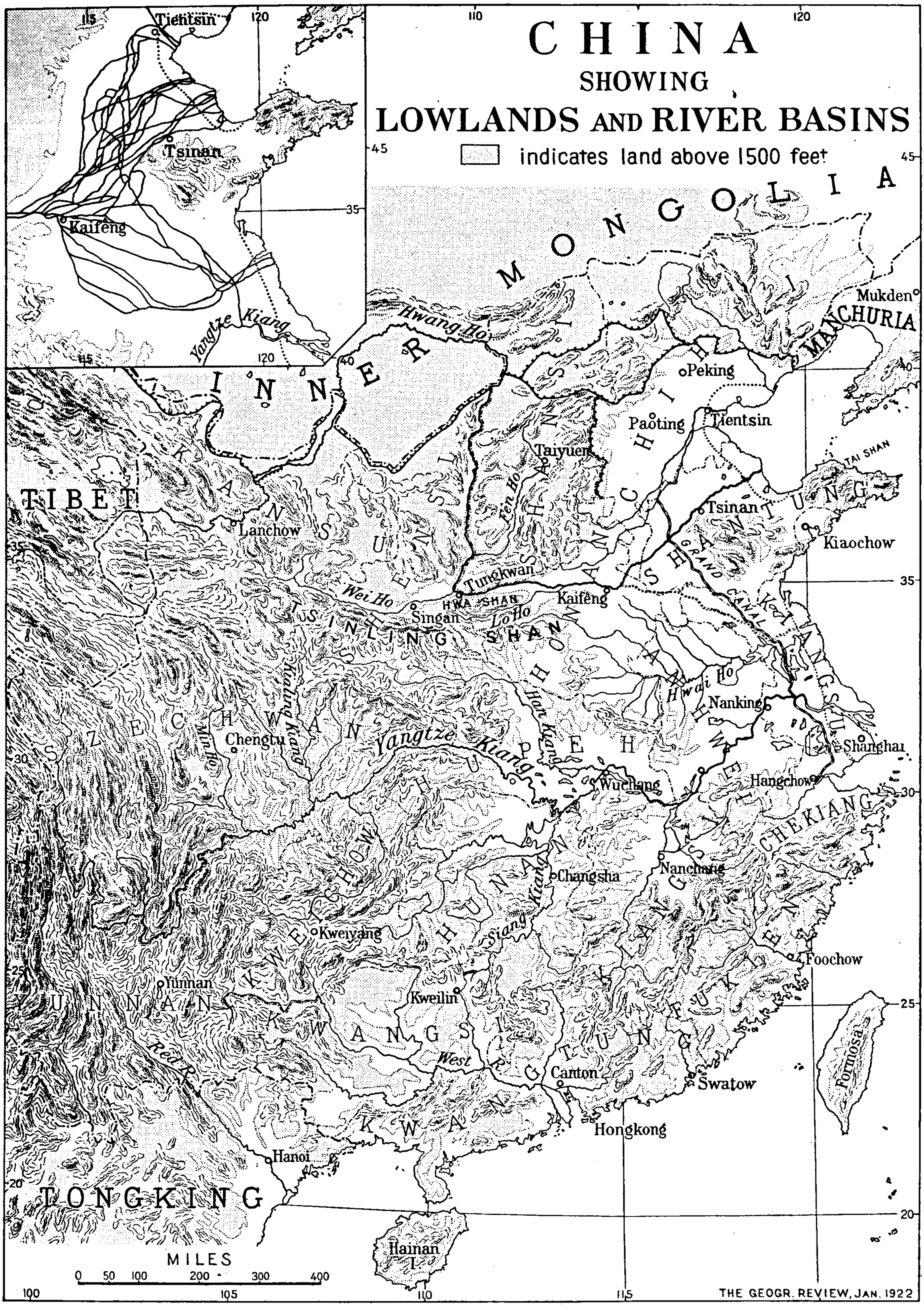


FIG. 1—Map of China showing lowlands and river basins. Note especially the Tsingling Range (part of the Hwang Ho-Yangtze divide) which with its lower eastward extension has always formed the real boundary between northern and southern China. (Scale of map 1 : 20,000,000.) Inset map showing changes in the lower course of the Hwang Ho and the seaward growth of the shoreline since the earliest historic times.

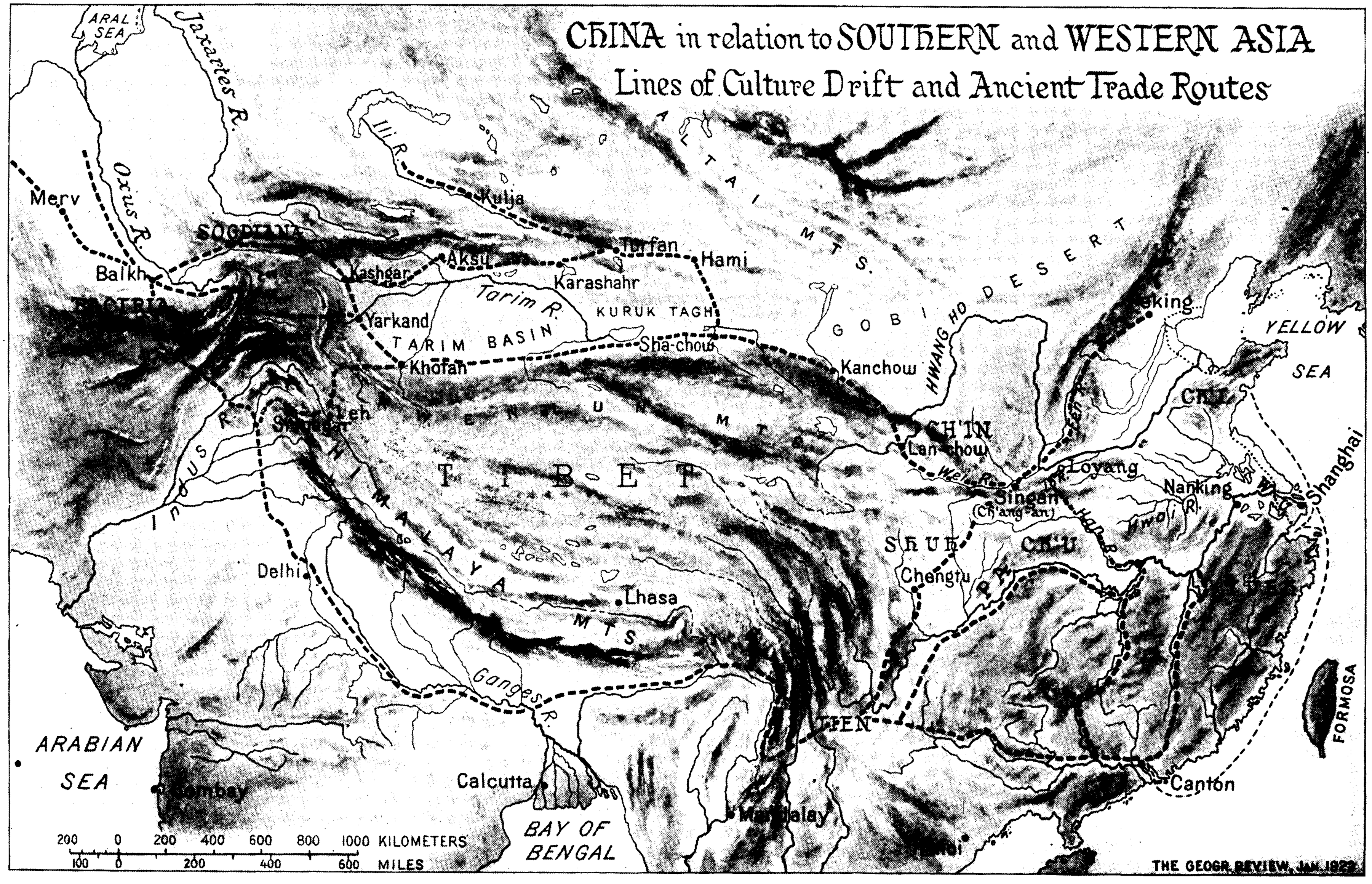


FIG. 2—Map showing the main lines along which cultural influences from southern and western Asia have penetrated into China. Old trade routes also largely followed these lines. The location of the chief seats of the ancient Chinese states is shown, the names, as other ancient names, being printed in antique lettering.

empires of the Occident.[5] The economic systems of the three ancient civilizations, Sumero-Babylonian, Indo-Iranian, and Chinese, founded alike on agriculture and cattle breeding, show much identity in detail, and there appears to be little doubt that China was indirectly in contact with western civilization from the remotest ages.[6] Von Richthofen, who considers that the Chinese had learned agriculture in the oases of the southern part of the Tarim basin, says, truly, that they were never an absolutely isolated people.[7] Specifically this earliest-known Chinese civilization appears to be related, in some way not yet clearly made out, to the prehistoric culture of southern and southwestern Siberia—the so-called "Scythic" area.[8]

## Direction and Character of Cultural Spread

The Yangtze River only comes under historic notice nearly two thousand years later, early in the first millennium before the Christian era. The influences operating to bring about the growth of civilization here fall into two groups. The first and, in the long run, most potent set worked gradually southward from the valley of the Hwang Ho and hence are ultimately derivable from Central Asiatic sources. But it is becoming increasingly apparent that from prehistoric times there has been a very real and important culture drift setting from the Ganges valley through Upper Burma and so across to the upper waters of the Yangtze, whose course it has followed eastward toward the sea.[9] It is a course by which culture influences in the shape of British trade goods are still entering China, as Ainscough points out in his "Notes from a Frontier" (Shanghai, 1915).

The southeastern coast lands, shut off from the great interior basin by mountains once clad with dense subtropical forests, were civilized late, partly from the Hwang Ho and partly from the Yangtze areas. The process for the northern end of the territory was well under way by about 500 B. C., but farther south, in what are now Fukien, Kwangtung, Kwangsi, and Tongking, it hardly commenced until three or four centuries later. Part of this region, indeed, comprised in the modern province of Fukien, through

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[5] Berthold Laufer: Some Fundamental Ideas of Chinese Culture, *Journ. of Race Devel.*, Vol. 5, 1914–1915, pp. 160–174.

[6] This is recognized by even so conservative a scholar as the Rev. Ernst Faber (*The Chinese Recorder*, Vol. 27, 1896, p. 548). Prof. Wm. Ridgeway (The Origin of Metallic Currency and Weight Standards, Cambridge, 1892) says that there is little doubt of a complete trade connection from extreme western Europe to China from the most remote times.

[7] Ferdinand Freiherr von Richthofen: China: Ergebnisse eigener Reisen und darauf gegründeter Studien, Berlin, 1877, Vol. 1, p. 48, footnote.

[8] On this question see P. Reinecke: Ueber einige Beziehungen der Alterthümer China's zu denen des skythisch-sibirischen Völkerkreises, *Zeitschr. fur Ethnologie*, Vol. 29, 1897, pp. 141–163; also A. de Mortillet: L'Age du Bronze en Chine, *Rev. Anthropol.*, Vol. 23, 1913, pp. 397–415; Sir C. Hercules Read: Siberian Bronzes and Chinese Jade, *Man*, Vol. 17, 1917, pp. 1-4.

[9] Regarding the route followed by this line of culture penetration see Sir A. P. Phayre: History of Burma, London, 1884, pp. 4 *et seq.* and 15; L. W. Shakespear: History of Upper Assam, Upper Burmah, and North-Eastern Frontier, London, 1914, p. 8; G. E. Gerini: Researches on Ptolemy's Geography of Eastern Asia (Further India and Indo-Malay Archipelago), Asiatic Soc. Monographs, No. 1, London, 1909, pp. 28, 60 *et seq.*, 122, 124, 285, and 660, footnote 2; and Émile Rocher: La province chinoise du Yün-nan, 2 vols., Paris, 1879. 1880; reference in Vol. 2, p. 264 *et seq.*

FIG. 3

FIG. 4

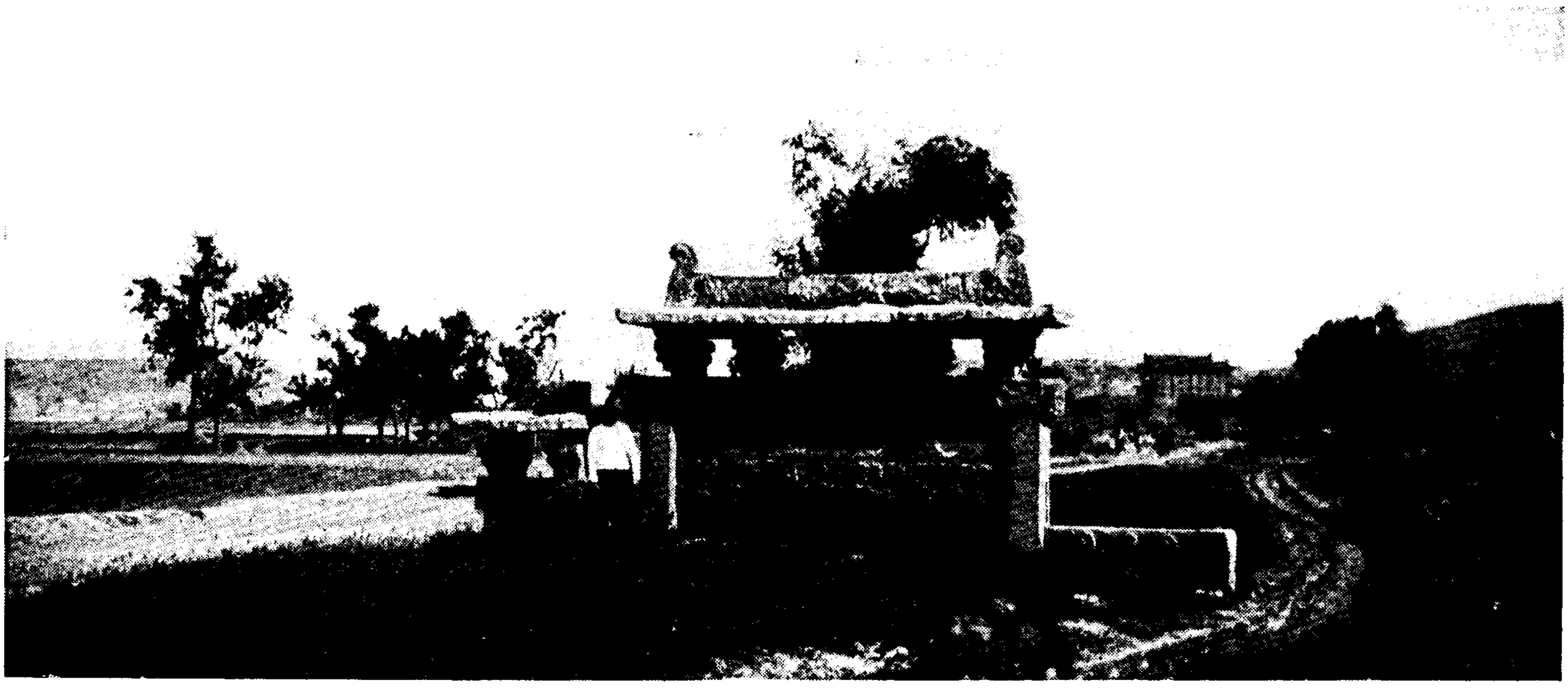

FIG. 5

FIG. 3—Three of a series of beacon towers in northern Shansi near the line of the Great Wall, to give warning by fire or smoke signals of the approach of Tatar invaders. Now displaced by a line of telegraph seen to the left. This and the following photographs were taken by the author for the University Museum, Philadelphia.

FIG. 4—Winter scene in northern Shansi village; little snow; but weather intensely cold, and people mainly hibernating; fuel on roofs. Tatar influence is strong in northern Shansi; see, e.g., mounted man in picture.

FIG. 5—This memorial gateway (pai-lou) was erected about 1795, near where the Wei flows into the Yellow River; owing to deforestation of the hills near the road, it has been buried not less than 12 or 14 feet deep in a little over a century.

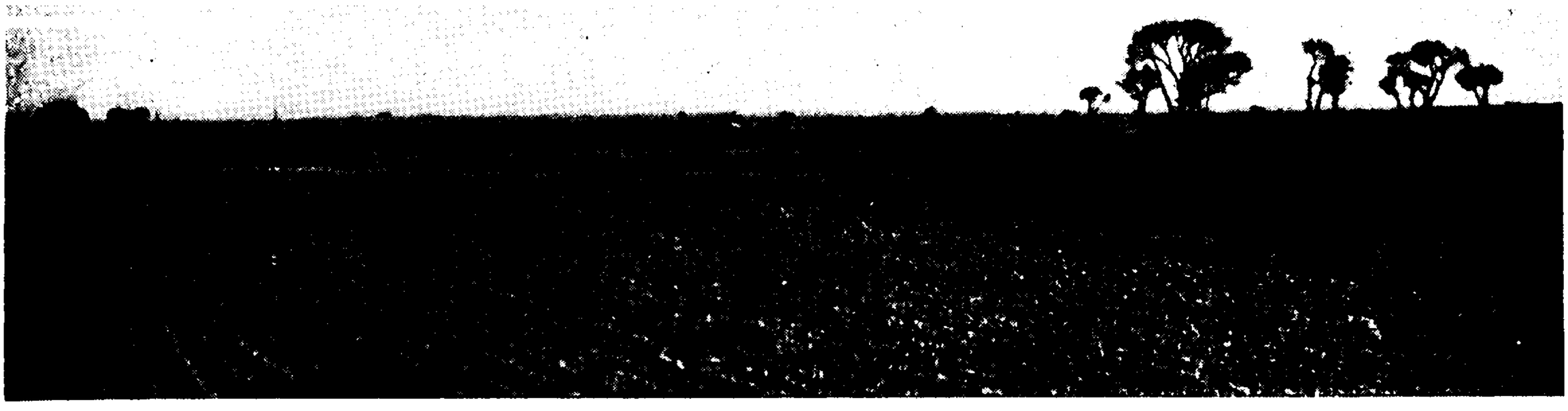

FIG. 6

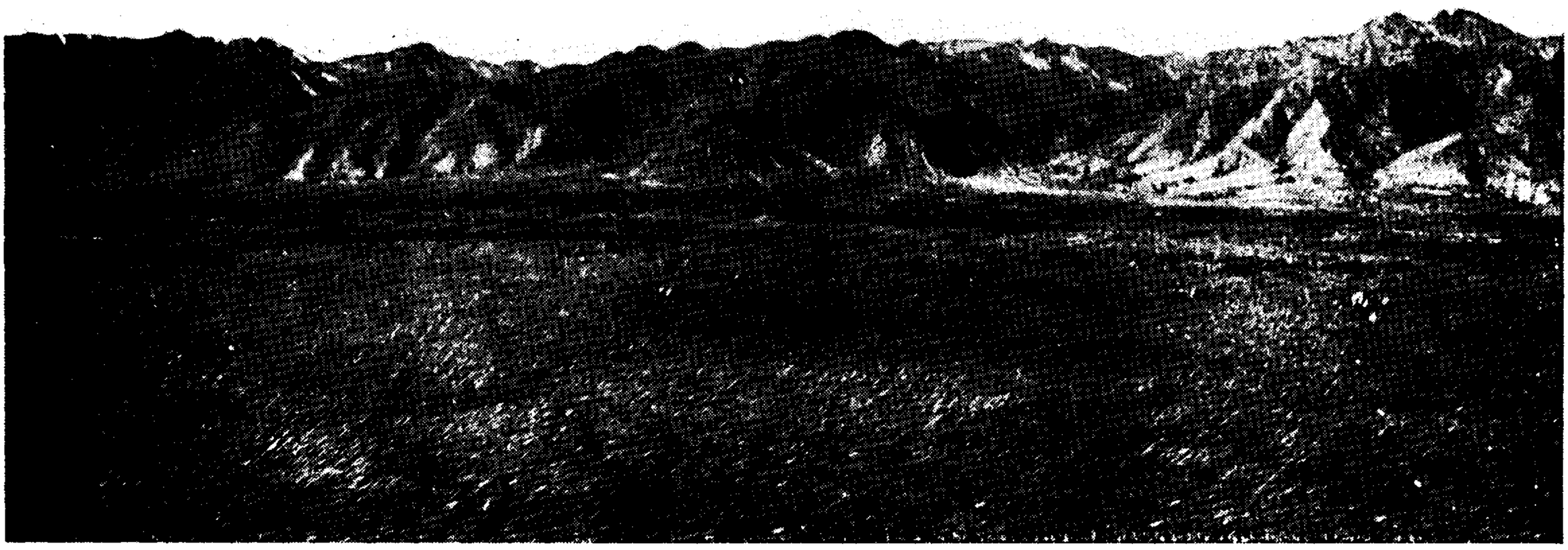

FIG. 7

FIG. 8

FIG. 6—A portion of the north China plain, showing its monotony broken only by grave mounds, clumps of trees spared for economic value or religious reasons, and mud-walled villages. In ancient times it was customary to run furrows parallel with the frontier to hinder the war chariots of invaders.

FIG. 7—Mountains of northern Shansi, near the line of the Great Wall, showing deforestation. Records show that these mountains were once clad with magnificent deciduous forests.

FIG. 8—Torrent bed in northern Shansi, showing how deforestation has ruined valuable river bottoms by allowing gravel and boulders to be washed down over them.

just this lack of water communication with the interior, was not permanently incorporated within the Chinese Empire until so late as 939 A. D.

Owing to peculiarities of terrain in the western region, the culture spread there has been not along but athwart the principal rivers, which have been obstacles rather than aids to its diffusion. The region owes its importance to the fact that here the Yangtze valley approaches most nearly to the Burmese area, thus providing an avenue for the infiltration into Central China of those Indian influences just mentioned. Burma and Yünnan form a geographical unit that at times has also been a political unit.[10]

The most westerly point to which the origins of Chinese civilization can as yet be traced with assurance is on the upper waters of the Wei. This river drains eastern Kansu and central Shensi, falling finally into the Hwang Ho not far from the point where the latter makes its great bend eastward. Many of the earliest myths of the Chinese people are localized in its valley; and, what is more, these same myths are just those which preserve most definitely features connecting them with the folklore of western Asia and eastern Europe. Among these is the belief in beings with serpent bodies and human heads. The mythical Chinese civilizer, Fu-hi, a creature of this description, is said to have been born near the sources of the Wei, in Kansu; and the legends about him are localized mainly in the northwestern provinces of Shansi, Shensi, and Kansu.[11] The introduction of metal is ascribed to him[12] rather significantly, in the first place on account of this very connection of his with the west, and, secondly, because a similar mythological concept of a human-headed serpent also appears in that same Scythic area to which China appears to have been culturally related. Another parallel to a well-known western belief is the legend of the supernatural "great bull of the River Fêng,"[13] and there are accounts of white horses, especially white chariot horses, which suggest Occidental contacts.[14]

It was here in the basin of the Wei that the old Bronze Age civilization of China received its definite and specialized form. And apparently here it remained for a long period before it pushed on still farther east, into the great North China plain, then occupied by Neolithic barbarians who lived mainly by hunting and fishing, eked out with a primitive horticulture carried on by the womenfolk with the aid of great stone hoes precisely like those employed by some tribes of our own American Indians.

When, some time after 3000 B. C., this invasion took place, it was not, it would seem, as a concerted movement, undertaken upon a large scale all at once. What really occurred was probably a sort of culture penetration carried on slowly by traders, refugees, captives, stragglers, and, possibly,

[10] J. Klaproth: Tableaux historiques de l'Asie, Paris, 1826, p. 128; R. F Johnston: From Peking to Mandalay, London, 1908, p. 287; and W. W. Cochrane: The Shans, Rangoon, 1915, p. 49.

[11] Édouard Chavannes: Les mémoires historiques de Se-ma Ts'ien, 5 Vols., Paris, 1895–1905; reference in Vol. 1, p. 5, footnotes 2, 4, 5.

[12] Doré, *op. cit.*, Vol. 10, p. 716.

[13] Chavannes, *op. cit.*, Vol. 2, p. 18 and footnote 2.

[14] Legge, Shu King, "Chinese Classics," Part IV, Bk. 1.

small bodies of actual invaders. In the early legends [15] a prominent part is played by Hwang Ti and may indicate, as pointed out by E. T. Williams, that he was really the leader of a band of immigrants. His name, or rather title, is usually translated "Yellow Emperor," though the correctness of this has been questioned. Whatever its meaning, it may well have been the title borne by a succession of sacerdotal rulers: "Ti" connotes divinity, and might suitably be applied to a god king of the type widely spread among primitive agricultural peoples. At all events it is clear, as Dr. Williams says, that this cycle of legends is referable to extreme northwestern regions and not at all to the lower valley of the Hwang Ho, the later "Middle Kingdom."

## Small City States Ancestors of Modern Townships

The result was the establishment, not of a single centralized "empire," but of a vast number of small city states, the ancestors of the modern *hsien* or townships, each under the control of a ruling clan with a patriarchal organization and a culture not very different from that of the earliest Babylonia that we know historically. The simple, almost parochial, character of the social organization depicted in the old Chinese myths proves that the latter were at first told of petty communities. Furthermore, the legends say that Hwang Ti delimited 10,000 fiefs and built a city in each. This seems undoubtedly a folk recollection of a period of small city states.

In some cases these *hsien* actually retain to this day the same names that they bore as *kuo*, or independent states, 3,000 years ago. Their numbers are given as 10,000 under the Hsia Dynasty (said to have ruled 2205–1766 B. C., but here we are still in the legendary period); as 3,000 under the Shangs (1766–1122 B. C.); and as 1,800 at the beginning of the Chou period (1122 B. C.).[16] This progressive reduction in the number of the fiefs was of course accompanied by a corresponding increase in size; but even so, the 1,800 said to have been in existence at the close of the second millennium before the Christian era must have been tiny affairs, for the same area nowadays contains scarcely half as many *hsien* or townships. The average size of the modern *hsien* in Shantung, for example, is, according to R. F. Johnston,[17] only 520 square miles. As Professor Parker remarks, in early times the "country" of each feudal chief was his mud village and the few square miles of fields around it.

The tie which bound these primitive little states together in the sort of loose confederation which seems to have existed was not political but

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[15] On the legends see H. Kurz: Mémoire sur l'état politique et religieux de la Chine, 2300 ans avant notre ère, selon le Chou king, *Journ. Asiatique*, 2nd Ser., Vol. 5, 1830, pp. 401–436 and Vol. 6, pp. 401–451; Léon de Rosny: Shan-haï-king, Paris, 1891, *passim;* M. Bazin aîné: Notice du Chan-haï-king, cosmographie fabuleuse attribuée au Grand Yu, *Journ. Asiatique*, 3rd Ser., Vol. 8, 1839, pp. 337–339; John Ross, *op. cit.*, Ch. 1; Léon Wieger: Textes historiques, Shanghai, 1903, pp. 23–47; Chavannes, *op. cit.*, Vol. 1, Ch. 1; Wang Ch'ung: Lun-Hêng (Alfred Forke's transl., 2 vols., 1907), *passim.*

[16] See Kanichi Asakawa: The Early Institutional Life of Japan, Tokyo, 1903, p. 188; also Wieger, *op. cit.*, p. 103.

[17] R. F. Johnston: Lion and Dragon in Northern China, London, 1910, p. 16.

religious. Its outward manifestation consisted in the common periodical worship of the sky, whose chief minister, the T'ien Tzŭ, or "Son of Heaven," was far more a priest than he was a king, although he seems already, three or four thousand years ago, to have evolved beyond the stage where he was actually a god himself, *in propria persona*.

## Importance of the Fên and Lo Valleys

For the first two thousand years or so after its emergence from the Wei valley the old Chinese civilization was confined almost wholly to the banks of the Hwang Ho and its affluents. Among the latter, one of the most important was the Fên, in southwestern Shansi, whose valley was apparently

FIG. 9—On the upper Yangtze near the upper end of the Gorges; style of boat known as a *wu-pan*.

one of the earliest occupied and where in time there grew up a powerful state. There are reasons, indeed, for believing that this region was a center of Chinese culture even earlier than the valley of the lower Hwang Ho itself. Many of the oldest legends are localized here, and the earliest dynasty, that of the Hsia, is said to have been centered here. The important state which occupied this area during much of the first millennium before the Christian era retained the use of the very ancient Hsia calendar, with the year beginning in March. Another center of civilization was the valley of the Lo, which flows into the Hwang Ho from the southwest in what is now north-central Honan. Its importance was mainly due to the fact that it formed, with a short and easy portage, the best avenue of communication with the Yangtze basin. This route dates back to the earliest recorded times and undoubtedly exerted a controlling influence in the dissemination of the Bronze Age culture southward from prehistoric ages onward. In the opposite direction the farthest outposts of Chinese civilization were located

on either side of the mouth of the Hwang Ho, which then entered the Gulf of Chihli near the modern Tientsin.

The one instance in which the protohistoric Chinese spread beyond the Hwang Ho basin was in the case of the Hwai River, whose headwaters, in central Honan, they occupied at an early date. But the conquest of the middle and lower course of this stream was quite beyond their power. A half-drowned region inhabited by a stubborn race who fought largely from canoes, the Chinese with their clumsy war chariots could do nothing with it, and it remained independent for something like two thousand years. The thickly forested mountains of Shansi and Shantung and the height of land bounding the Hwang Ho basin on the southwest also remained un-

FIG. 10—Hwang Ho (Yellow River), from the crossing of the Peking-Hankow railway, at low water.

conquered,[18] as did the regions near the seacoast. The fact was that, as is commonly the case with early civilizations, that of Bronze Age China, while admirably adapted for the particular sort of environment in which it was evolved, possessed little flexibility or power of adjustment. Based fundamentally upon the plow in peace and the chariot in war, in hilly or wooded country or in regions of jungle or swamp it found itself helpless; and such areas, whether as frontier lands or as enclaves surrounded by the civilized Chinese states, remained free and unassimilated for ages.

Toward the close of the second millennium before the Christian era a fresh access of culture influences from the West reached northern China in

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[18] On the ancient forests of China, see the Shi King ("Odes") *passim;* Mencius (Legge's transl.), Vol. 1, Part I, Ch. 3, par. 3; J. J. M. de Groot: The Religious System of China, 6 vols., Leiden, 1892–1910; reference in Vol. 5, p. 660 *et sqq.;* Édouard Biot: Recherches sur les mœurs des anciens Chinois, d'après le Chi-king, *Journ. Asiatique,* 4th Ser., Vol. 2, 1843, pp. 307–355 and 430–447; reference on p. 323; and *idem:* Le Tcheou-li, ou Rites des Tcheou, 2 vols., Paris, 1851, Ch. 37. For an interesting description of the last existing bit of the ancient North China forest, see A. W. S. Wingate: Nine Years' Survey and Exploration in Northern and Central China, *Geogr. Journ.,* Vol. 29, 1907, pp. 174–200 and 273–306.

connection with what is known historically as the Chou conquest. And here again it is the Wei basin that is found playing the leading part.

## The Chou Conquest from the Wei Basin

Lying at the eastern extremity of the ancient line of culture drift across Asia and separated from the North China plain by somewhat definite mountain barriers, this basin has played the part time after time of a storage reservoir in which both fragments of peoples and scraps of civilizations have found lodgment. Under the influence of such highly complex stimuli a culture would be formed there, only to overflow at length upon the rich plains to the eastward and there undergo a further and larger development along the lines already determined for it. The Chou conquest of China, while probably far from being the first instance of this process, is the earliest of which we have actual historical accounts.

The Chous, when we first hear of them, are found dwelling in the upper portion of the Wei basin. Who they were, or whence they came, we do not know. Racially they were probably rather closely akin to the early Chinese. But one of their oldest myths claimed for their ruling house descent from a maiden mother and miraculously conceived son of a familiar West Asiatic type and, like the latter, patron divinities of agriculture.[19] Moreover the Chous introduced into the Hwang Ho valley the harem system with eunuch attendants so well established in Babylonia and adjacent lands but hitherto unknown in China. And in the period immediately succeeding their conquest of China proper they were in touch with places in the west which are apparently to be sought for in the Tarim or Turfan regions.

During the first three centuries or so of their rule over China proper the Chous retained their headquarters in the Wei basin, although they established a secondary capital in their newly won possessions to which they made royal progresses from time to time, to offer the great state sacrifices and receive the homage of the assembled feudal lords. For some time they appear to have entertained designs of conquering the nearer portions of the Yangtze valley, and several of their early rulers are recorded as having invaded those regions. But they achieved no permanent annexations, and the southern frontier of the Chinese culture area in the early part of the first millennium before the Christian era seems to have been pretty much where it had been for the past thousand years or more, along the water parting between the Hwang Ho and the Yangtze.[20]

Eventually, in the eighth century before Christ, the ruling house of the Chous, already greatly weakened by internal decay as well as by various external causes, were forced out of their ancient seats in the Wei valley by

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[19] See on this Legge, Sacred Books of the East, Vol. 3, pp. 319 *et seq.*, 396, 398, and footnote 1; also Chavannes, *op. cit.*, Vol. 1, p. 209 *et seq.* This concept of a Mother Goddess and Divine Son, particularly as patrons of agriculture, is of course well known in the Occident, especially in Asia Minor and Syria.

[20] For an interesting account of the founding of a town in this region (modern Fêng-chou, Nan-yang prefecture, Honan) as an outpost against a non-Chinese people, see Legge, Sacred Books of the East, Vol. 2, p. 424 and footnote 1.

predatory tribes from the west and compelled to remove to their eastern capital of Loyang, on the Lo River, in ancient China proper. Thus deprived of their old native territorial and fiscal base,[21] they speedily lost what little remained to them of temporal power and degenerated into a line of *fainéant* priest kings whose sacerdotal character alone secured for them a further existence of several centuries. None of the Chinese states which had grown up out of the fiefs they had apportioned out after their conquest of China ever ventured, indeed, upon the sacrilege of overthrowing them; and the extinction of their line was the work of a fresh invasion from the west in the third century before Christ.

## Climatic Cycles and Folk Movements

Here parenthetical remark may be made regarding a curious set of coincidences in connection with the early history of civilization in China. Ellsworth Huntington has shown[22] that there has occurred in Babylonia and the eastern Mediterranean region a succession of periods of humidity and general prosperity alternating with others of dryness and general disturbances. These periods he has traced from around 2200 B. C. to 750 B. C. The striking parallelism with contemporaneous conditions in China can best be presented in tabular form:

| Occident | | China | |
|---|---|---|---|
| 2200 to 1750 B. C. | Period of humidity and general prosperity and progress | 2205 B. C. | First dynasty founded |
| 1700 | Center of period of dryness with invasions from the desert and domestic disturbances | 1766 | First dynasty overthrown by a popular revolt following seven years of drought |
| 13th century | Period of dryness with consequent famines, domestic turmoil, and invasions | 1122 | Second dynasty overthrown by popular revolt and invasion from the west |
| 870 to 750 | Probably somewhat dry period | 842 to 771 | Period of turmoil and invasion from the west; great drought, accompanied by disturbances, recorded for about 822 B. C. |

[21] Wang Ch'ung (Lun-Hêng, Alfred Forke's transl., 2 vols., 1907; reference in Vol. 1, p. 438) says that Wu Wang, the founder of the Chou line, relied on the people of his original fief of Chou, in the Wei valley, to fight his battles for him, and that all the early dynasties regarded the district of their origin as the basis of their power. Cordier (*op. cit.*, Vol. 1, p. 127) says that the decadence of the Chous began with their removal to Loyang.

[22] Ellsworth Huntington: Palestine and Its Transformation, Boston and New York, 1911, pp. 383–398.

These coincidences seem almost too numerous and too exact to be purely fortuitous. Perhaps we may at least take them as indicating that the major periods of humidity and of aridity have made their influence felt in precisely the same way at both extremities of the Asiatic continent.

## The Introduction of Iron

It was probably about the middle of the Chou period, or somewhere about the eighth or seventh centuries before Christ that bronze as the predominant metal in Chinese civilization began to yield its supremacy to iron. That iron was known in western Asia before it reached the central and eastern portions of the continent seems probable. De Morgan[23] remarks that it was already in common use in Assyria, Asia Minor, and Armenia before it penetrated to the regions east of the Caspian. According to the British Museum's "Guide to the Antiquities of the Bronze Age" (1904) iron was not generally employed in Mesopotamia till about 1000 B. C., while the "Guide to the Antiquities of the Early Iron Age" (1905) gives the same date as approximately marking the end of the exclusive bronze culture in classical lands. W. M. Flinders Petrie[24] says that iron was introduced into Egypt about 800 B. C., while Professor Ridgeway[25] gives about 860 B. C. as the date of the earliest mention of iron in the Assyrian tablets. Hence, unless we suppose that the Chinese worked out independently the method of reducing iron ores, which while of course not impossible seems on the whole unlikely, the ascription of its earliest use by them to the eighth century before Christ or thereabout seems in the light of our present knowledge most probable.[26]

The Yü-kung, or "Tribute of Yü," which in its present form seems to date from about that time or perhaps a century or so earlier,[27] speaks of gold, silver, and copper as "the three metals" but states that iron is obtained from Liang Chou, a western region which included at least part of the modern province of Kansu. And there can be little doubt that it was by this age-old Central Asiatic route to the headwaters of the Wei that the Chinese obtained their knowledge of the new metal. Its employment seems at first to have been confined, as in other lands, to the fabrication of domestic utensils, bronze being retained for weapons and ceremonial objects.

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[23] J. de Morgan: Mission scientifique au Caucase: Études archéologiques et historiques, 2 vols., Paris, 1889; reference in Vol. 1, p. 38.

[24] W. M. Flinders Petrie: Ten Years' Digging in Egypt, 1881–1891, New York, n. d., p. 152.

[25] William Ridgeway: The Early Age of Greece, 2 vols., Cambridge, 1901; reference in Vol. 1, p. 616.

[26] Taxes are mentioned as levied on iron in the seventh century before Christ (Forke, *op. cit.*, Vol. 2, p. 72, footnote 5). De Groot (Religious System, Vol. 1, p. 287) says merely that iron was in general use in China during the Chou period (1122–255 B. C.). De Mortillet, on the other hand (*loc. cit.*, p. 399), says that bronze was not replaced by iron in China until the Ch'in Dynasty (late in the third century before Christ). There is a solitary statement (see Wieger, *op. cit.*, p. 59, and Biot, Mœurs, p. 332) to the effect that iron was mined and made into swords as far back as around 1800 B. C., but in the light of the other evidence this is surely an anachronism. The question is discussed at length by Professor Hirth in his "Chinesische Ansichten über Bronzetrommeln," Leipzig, 1904, p. 17 *et seq.*

[27] On the dating of the *Yü-kung* see Chavannes, *op. cit.*, p. cxli; Legge, Shu King, Sacred Books of the East, Vol. 3, p. 64, footnote 1; Arthur Morley: A Study in Early Chinese Religion, *New China Rev.*, Vol. 1, 1919, pp. 176–208, 262–281, and 372–384; reference on p. 177; and *idem*, "The Yü-kung Classic," *Chinese Recorder*, Vol. 45, 1914, p. 238 *et seq.*

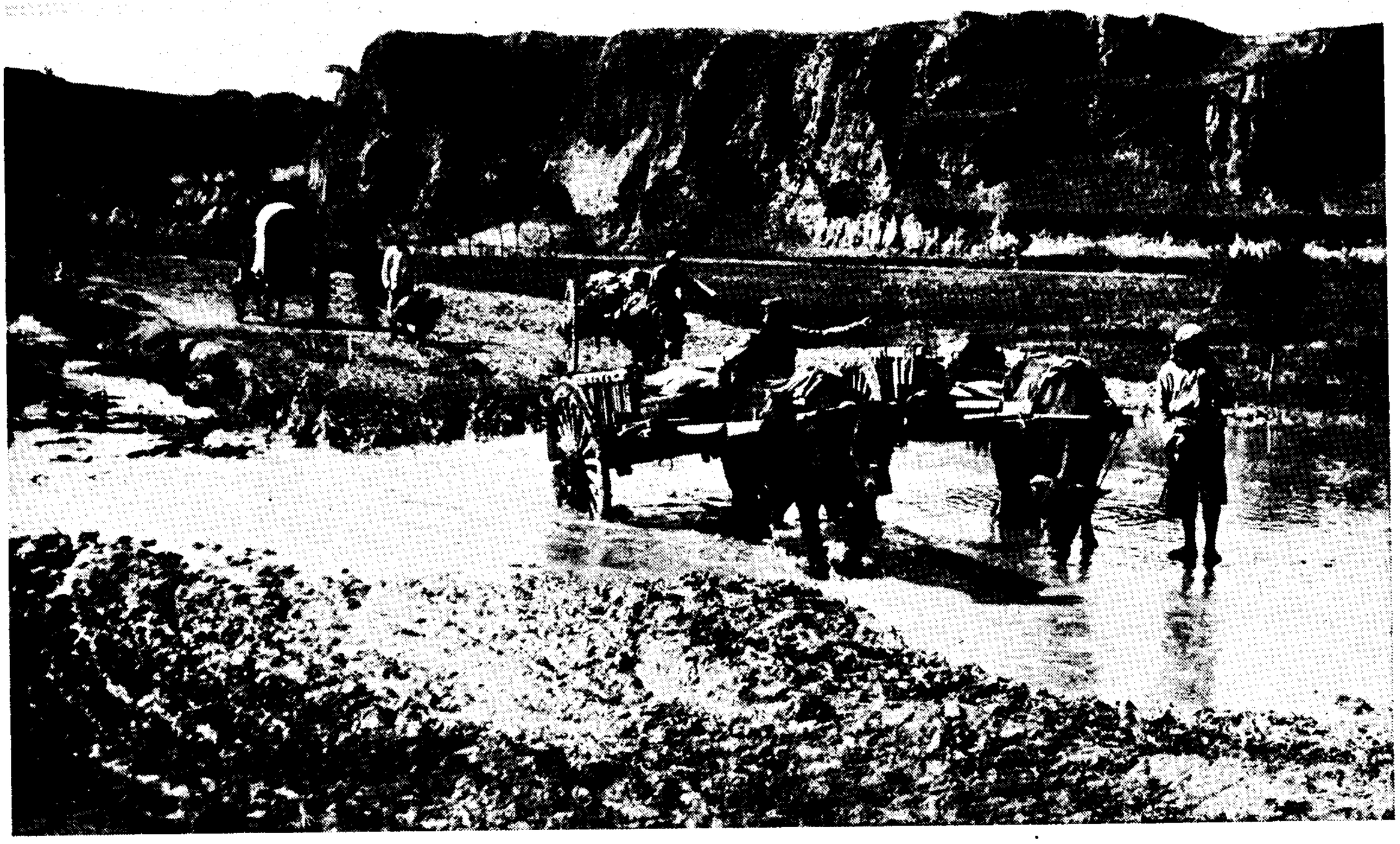

FIG. 11



FIG. 12

FIG. 11—The road from Loyang to Sian fu, called by Richthofen "the worst road in China." In the distance the loess scarp marks the edge of the valley (of a small southern affluent of the Wei). These loess bluffs are in many places honeycombed with artificial caves used as dwellings.

FIG. 12—Hamlet of Yün-Kang in northern Shansi. Famous Buddhist grottoes of the fifth century of our era, located here, formed in their prime the worshipping place of emperors and the object of pilgrimages. They are now practically deserted and almost unknown. The picture shows a very primitive type of ox cart. Notice the wheels without spokes.

## The Kingdom of Chou in the Yangtze Valley

While there are earlier allusions to the area and its people, the first references to the cultural development of the Yangtze valley region date early in the first millennium before the Christian era. We then find rising there, on the north bank a little way below the famous gorges, the "barbarian," or non-Chinese, kingdom of Ch'u. The old Chinese name for this region was Ching Chou, or "Jungle-Land," and the character with which the name Ch'u itself is written contains as one of its elements the symbol for a forest. The delay of two thousand years which occurred before the Chinese culture succeeded in penetrating this area from the Hwang Ho valley, only a short distance to the north, was undoubtedly in great part due to the thickly forested character of this ancient lake bed, now one of the most densely populated and intensively cultivated portions of all China.

There is some reason to believe that the ruling element, at least, in Ch'u was of the great and highly gifted T'ai race, of which the Siamese, the Shans, and the Laos are the best known modern representatives.[28] At all events its growth was steady, and it rapidly became the leading state of the great valley, exercising a vague suzerainty even as far as the sea. But it was not until the latter part of the fourth century before Christ that it attained to its greatest power. At that time it had pushed its conquests up the Yangtze and its affluent, the Han, into eastern Szechwan and southern Shensi, on the one hand; while, on the other, it had after a savage struggle definitely subjugated and annexed the entire valley as far as the sea and had even made tributary the coastal regions extending southward from the mouth of the Yangtze. It had further succeeded, as the Chinese themselves had never done, in subduing the stubborn inhabitants of the Hwai valley; and it had also made important annexations among the native Chinese states in the Hwang Ho valley itself. Finally, toward the close of the century it despatched an army up the Yangtze to seize the Ta-li fu region in western Yünnan, in part no doubt for the purpose of securing control of the trade from Indian regions which was likely otherwise to be diverted northeastward, through Szechwan, to the rival state of Ch'in, then coming into prominence in the historic old Wei River basin.

## Early Cultural Foci in the West

Meanwhile, in the Yangtze valley above Ch'u two independent culture foci had appeared, in the valleys of the Chia-ling and the Min, in the modern Szechwan. Here, as might be expected, Indian influences appear to have been particularly strong.[29] Rice and sugar cane remain to this day among the staple cultivated plants, while the water buffalo and the zebu, or humped

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[28] Cochrane, *op. cit.*, pp. 4, 17, and 19; J. H. Freeman, *Chinese Recorder*, Vol. 49, 1918, p. 456; Gazetteer of Upper Burma and the Shan States, Rangoon, 1901, Part 1, Vol. 1, p. 187 *et sqq.*

[29] For the first historical mention of trade between this region and India, in the second century before Christ, see A. Wylie: History of the South-Western Barbarians and Chaou-sëen. Transl. from the "Tseen Han Shoo," Bk. 95, *Journ. Anthropol. Inst.*, Vol. 9, 1880, pp. 53–87; reference on p. 59.

Indian ox, figure prominently among the domestic animals. The details of hut construction among the peasantry are identical with those now or formerly extending over the whole of the Indo-Chinese area taken in its widest sense.

Farther west still the territory comprised within the west-central portion of the modern province of Yünnan was from the earliest times in close contact with the lands about the head of the Bay of Bengal. In this latter region, according to most authorities, originated the cultivation of irrigated rice with the aid of the water buffalo; and it was apparently by the Burma-Yünnan route that it penetrated to the Yangtze valley and in time to South

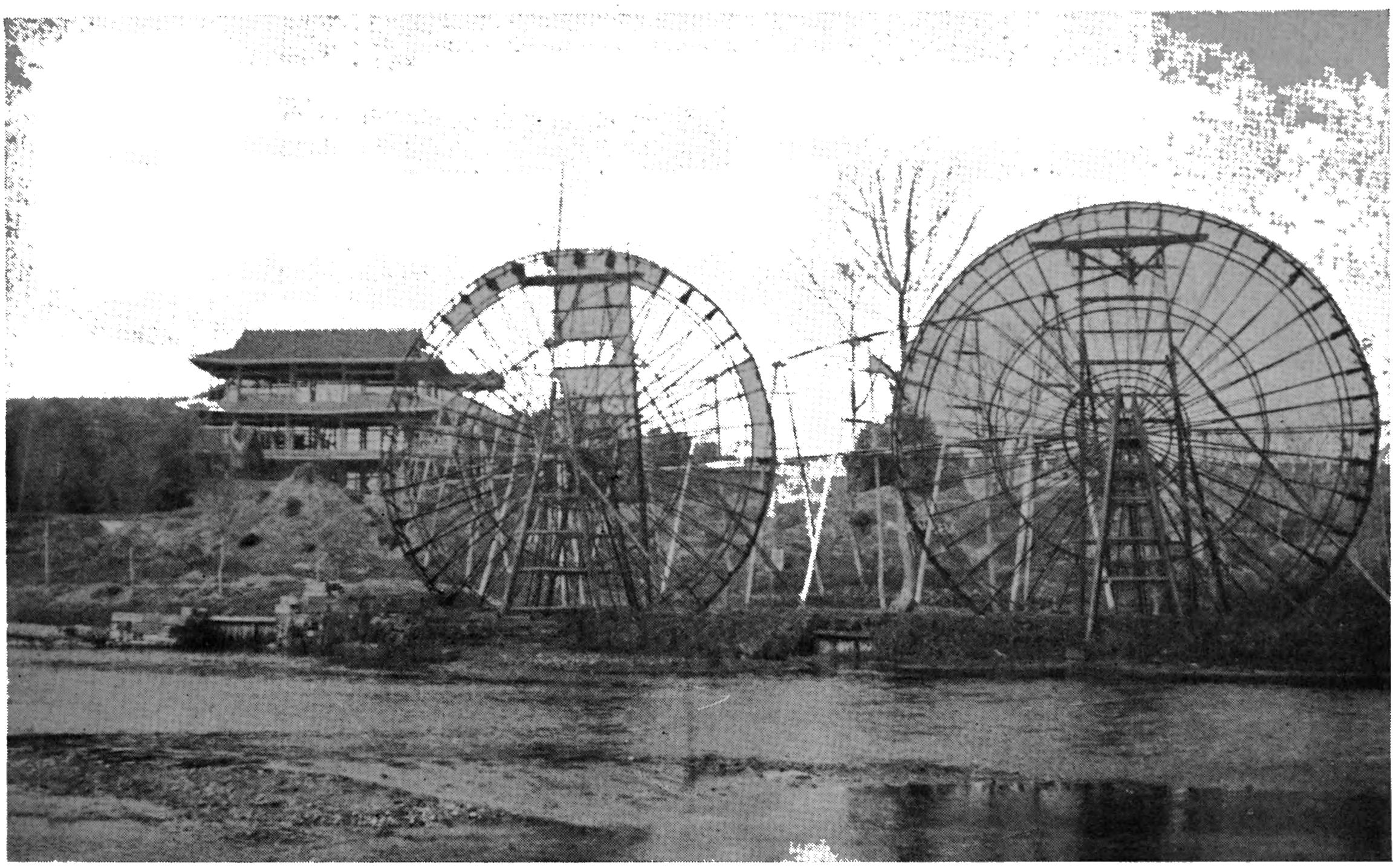

FIG. 13—So-called "Persian" water wheels outside the city wall of Ch'eng-tu, the capital of Szechwan and of the ancient kingdom of Shuh; the wheels are made of bamboo and are about 40 feet in diameter.

China generally. This cultivation appears the essential requisite to any cultural advance in southeastern Asia.[30] It was perhaps the acquisition of this staple foodstuff that eventually led to the rise of the large Yangtze River powers, from Szechwan to the sea, just as the cultivation of millet and wheat was what made possible the Chinese civilization of the Wei and Hwang Ho valleys, two thousand years earlier.

## THE MARITIME STATES OF WU AND YÜEH

At the other extremity of the great river, in the region about its lower course and embouchure, shortly before the middle of the first millennium before the Christian era there arose the state of Wu, supposed by some to

[30] W. W. Skeat and C. O. Blagden: Pagan Races of the Malay Peninsula, 2 vols., London, 1906; reference in Vol. 2, p. 451.

have been peopled by a stock akin to the modern Annamites. By means of fleets of large war canoes—ancestors of the modern "Dragon boats" of festival fame[31]—this kingdom managed to render tributary much of the Chinese seaboard. It also carried on with its ancient suzerain, Ch'u, a long and bitterly contested war, in the course of which it took and sacked Ch'u's capital. Wu seems, however, to have tried to do too much and to have exhausted itself in the effort; for early in the fifth century before Christ it collapsed, completely and once for all, before an assault by a state of kindred stock and culture just to the south, known as Yüeh, whose capital was located on the southern shore of the Bay of Hangchow. This state, even more purely a maritime power than Wu, rapidly extended its conquests up and down the coast as well as along some of the inland waterways and even for almost a century located its capital on that Kiaochow Bay in Shantung about which we have been hearing so much during the past few years. Eventually, however, in the fourth century before Christ it was conquered and incorporated by Ch'u, which at the same time laid under tribute the seaboard regions farther south. But Ch'u, with its administrative center a thousand miles up the Yangtze, could exert little influence in regions so distant; and these coast lands, composed of a large number of separate small principalities, appear speedily to have regained their complete independence.

And now it is necessary to turn once more to that Wei River valley already so often mentioned, whose geographical position affords the key to the development of Chinese civilization from prehistoric times.

## The Contest Between Southern and Western Cultures

The fundamental fact in the creation of the Chinese Empire as the centralized, bureaucratic, and theoretically absolute monarchy which existed until the other day is the tremendous century-long struggle between the states of Ch'u with its essentially Indo-Chinese culture, on the one hand, and of Ch'in with its Central Asiatic affinities, on the other, for the mastery of the Yangtze valley. It was a struggle *à outrance*, in which there could be neither compromise nor giving of quarter. It entailed for the victorious power such success as rarely falls to the lot of any people; but for the loser, nothing short of total annihilation as a distinct ethnic and political entity.

Of the growth of Ch'u a sketch has already been given. The rise of its great opponent, the state of Ch'in, dates from the time when the Chous, in the eighth century before Christ upon evacuating their ancient western seats, made its ruler, until then a mere petty feudal chieftain, Warden of the

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[31] On Wu's raids by sea and river see Legge, Chinese Classics, Vol. 5, Part II, p. 281. The fleets in which the coast peoples raided one another as well as the Chinese up the inland waterways undoubtedly consisted of great war canoes like those used by the Indo-Chinese nations almost universally until a few generations ago. See on these Col. A. Lane Fox: On Early Modes of Navigation, *Journ. Anthropol. Inst.*, Vol. 4, 1875, pp. 399–437; reference on p. 404 *et seq.*; Mrs. Ernest Hart, Picturesque Burma, Past and Present, London, 1897, p. 118.

On the modern Chinese "dragon boat" used in connection with the festival held on the fifth of the fifth moon, see Lewis Hodous: The Great Summer Festival of China as Observed in Foochow, *Journ. North-China Branch of the Royal Asiatic Soc.*, Vol. 43, 1912, pp. 69–80; reference on p. 76; J. J. M. de Groot: Les fêtes annuellement célébrées à Emoui (Amoy), 2 vols., Paris, 1886; reference in Vol. 1, p. 347.

Western Marches. Turkic relationship has been asserted for the people of this state,[32] and certain it is that in many ways they stand clearly differentiated from the natives of the ancient Chinese culture states of the North China plain. Warlike, ambitious, and savagely cruel on occasion, they were at the same time intelligent and progressive, and in their political, military, and economic organization were far ahead of China proper.

All that we know of the history of Ch'in, aside from the scanty information afforded by a few brief inscriptions,[33] is derived from the Chinese, who were bitterly hostile to it and who ascribed every advance in civilization which it made to the advice of various traitor Chinese refugees at its court. The cultural evidence, however, points strongly the other way, toward western Asia and particularly toward Persia, as the region whence Ch'in derived much of its civilization. The Persian Empire during the fourth century before Christ, it will be remembered, reached as far as the Jaxartes and the Indus, while Ch'in about the same period took in much of Kansu and portions of Szechwan, termini, respectively, of important trade routes from precisely the Jaxartes and Indus valleys.[34] As a consequence of these commercial relations the name "Ch'in" began to be known in western regions some centuries before the Christian era, and came to be applied by a species of geographical synecdoche to the whole Chinese culture area—an application which survives to this day in the majority of European languages. The Persians seem to have known of silk, which even reached Greece in small quantities at least as early as the fourth century before Christ. The Ch'in of the following century, we know, was aware of the existence of the Hellenic kingdom of Bactria, even beyond which, in one of its inscriptions, it claimed to have penetrated.[35] The great palace of Shih Hwang-ti, the most famous ruler of the House of Ch'in, as described to us by Chinese writers, though built of wood yet seems clearly of the western Asiatic rather than the Chinese type of that period;[36] it certainly impressed the contemporary Chinese as a very remarkable building, and apparently not wholly because of its vast size. And

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[32] Chavannes, Mémoires historiques. Cordier disagrees with Chavannes. See Legge, Chinese Classics, Vol. 4, Prolegomena, p. 141.

[33] Édouard Chavannes: Les inscriptions des Ts'in, *Journ. Asiatique*, 9th Ser., Vol. 1, 1893, pp. 473–521; reference on p. 481 *et seq.*

[34] On the old trade routes between China and the Occident see von Richthofen, *op. cit.*, Vol. 1, p. 459 *et seq.*; Sir M. A. Stein: Ancient Khotan, 2 vols., Oxford, 1907; reference in Vol. 1, p. 52 *et seq.*; Albert Herrmann: Die alten Seidenstrassen zwischen China und Syrien: Göttingen, 1910. Von Richthofen in his map in Vol. 1, opp. p. 386, puts the northwestern border of Ch'in at about the modern Lan-chou Fu, in Kansu, and fails altogether to show the annexation of Szechwan and the upper Yangtze basin by that state.

[35] Chavannes, Inscriptions, p. 500. On the relations between Bactria and China see Reinaud, Relations politiques et commerciales de l'Empire Romain avec l'Asie orientale, *Journ. Asiatique*, Ser. 6, Vol. 1, 1863, pp. 93–234 and 297–441; reference on p. 113, footnote 1. W. W. Tarn (Notes on Hellenism in Bactria and India, *Journ. of Hellenic Studies*, Vol. 22, 1902, pp. 268–293) remarks (p. 291) that the Bactrians apparently had access to the rich Central Asian gold deposits of the Altai till the reign of Eucratides, when they were cut off from them by the great tribal movements instituted by the conquests of the Huns and thinks that there probably was a good deal of trade between China and the West before the time of the Han emperor Wu-ti (c. 100 B. C.), when it is generally said to have commenced.

[36] For a description of this edifice see Wieger, *op. cit.* p. 269. On the spread of Persian architectural influences eastward, see E. B. Havell: The Ancient and Medieval Architecture of India: A Study of Indo-Aryan Civilization, London, 1915, p. 2 and *passim:* also Marcel Dieulafoy: Les piliers funéraires et les lions de Ya-tcheou fou, *Comptes rendus des Séances de l'Académie des Inscriptions et Belles Lettres*, 1910, pp. 362–377.

the court etiquette of Ch'in was decidedly Persian in many ways; any one, for example, who dared enter the Presence unbidden risked his life thereby. The whole institution of kingship in Ch'in, as a matter of fact, was far more developed and politicized than was the case anywhere in contemporary China. Hence even though Ch'in may never have come in direct contact with Persia—may never even have heard of such a country, though this is most unlikely—it seems quite certain that culturally it was deeply influenced by that great empire.

By the beginning of the fourth century before Christ the ten thousand small states which legend tells us once existed in the valley of the Hwang Ho had nearly all been consolidated into a few great ones, all of them contending for the supremacy but none of them able to achieve it. The T'ien Tzŭ, long since shorn of all temporal power, dwelt secluded and impoverished in his capital of Loyang, feared by none and reverenced, if at all, merely for his time-honored claim to be in some special way the intermediary between man and Heaven.

## Strategic Importance of the Yangtze Valley

The great non-Chinese kingdoms of Ch'u and Ch'in, on the other hand, were steadily growing more powerful and more menacing. Their opportunities for expansion at the expense of less civilized neighboring peoples were practically unlimited; their wealth of natural resources was such as would be accounted vast even today; and between them they controlled the only routes by which Western culture stimuli could reach China. There is, furthermore, some reason to believe that they had progressed further than the Chinese proper in the application of iron to the uses of war—an advantage which it would be impossible to exaggerate. The direct evidence for this is slight, but it seems probable in view of the superior opportunities enjoyed by Ch'in and Ch'u for receiving culture stimuli from the West, and their very evident superiority in war to the peoples of the ancient China proper along the Hwang Ho. Ch'ing, whose swords were specially prized, is identified by Biot[37] with a fief in the Wei valley; Wu and Yüeh are represented as eager for the iron of Ch'u in order to make weapons of it.[38] It was apparent that to either Ch'u or Ch'in was destined the mastery of southeastern Asia. And success was assured to that one which could secure and retain control of the Yangtze valley. The key to the Yangtze was the Han-chung region, on the extreme upper waters of the Han, in what is now southwestern Shensi. This region had been occupied at an early date by Ch'u, by whom its vital strategic significance was thoroughly understood; but after a long and bloody contest it was finally wrested away by Ch'in, who also about the same time—the last quarter of the fourth century—annexed the two culture areas in Szechwan, the basins of the Chia-ling and the Min.[39]

[37] Biot, Tcheou-li, Ch. 40, section 10 and note.

[38] Albert Tschèpe: L'histoire du royaume de Tch'ou, Shanghai, 1903, p. 42, footnote 2.

[39] *Ibid.*, p. 206; also Rev. Thomas Torrance: The Early History of Chengtu, Chengtu, SzechWan, 1916, p. 2 *et seq.*

Once the grasp of Ch'in upon the Han-chung and Szechwan regions was firmly established, the final overthrow of Ch'u and the conquest of the small, feeble, and disunited states of the Hwang Ho valley was only a question of time. Ch'u, however, resisted desperately, and the struggle was protracted, with varying fortunes, for almost a century longer. Even to the very last, by superhuman efforts Ch'u managed to hurl back again and again vast armies of the invaders. But Ch'in fought with the same obstinacy and determination that the Roman Republic was displaying during the same period in its two earlier wars with Carthage. Ch'u in the long run was forced back step by step out of its native Yangtze valley into the basin of the Hwai. When the final catastrophe came, the Ch'u capital was in

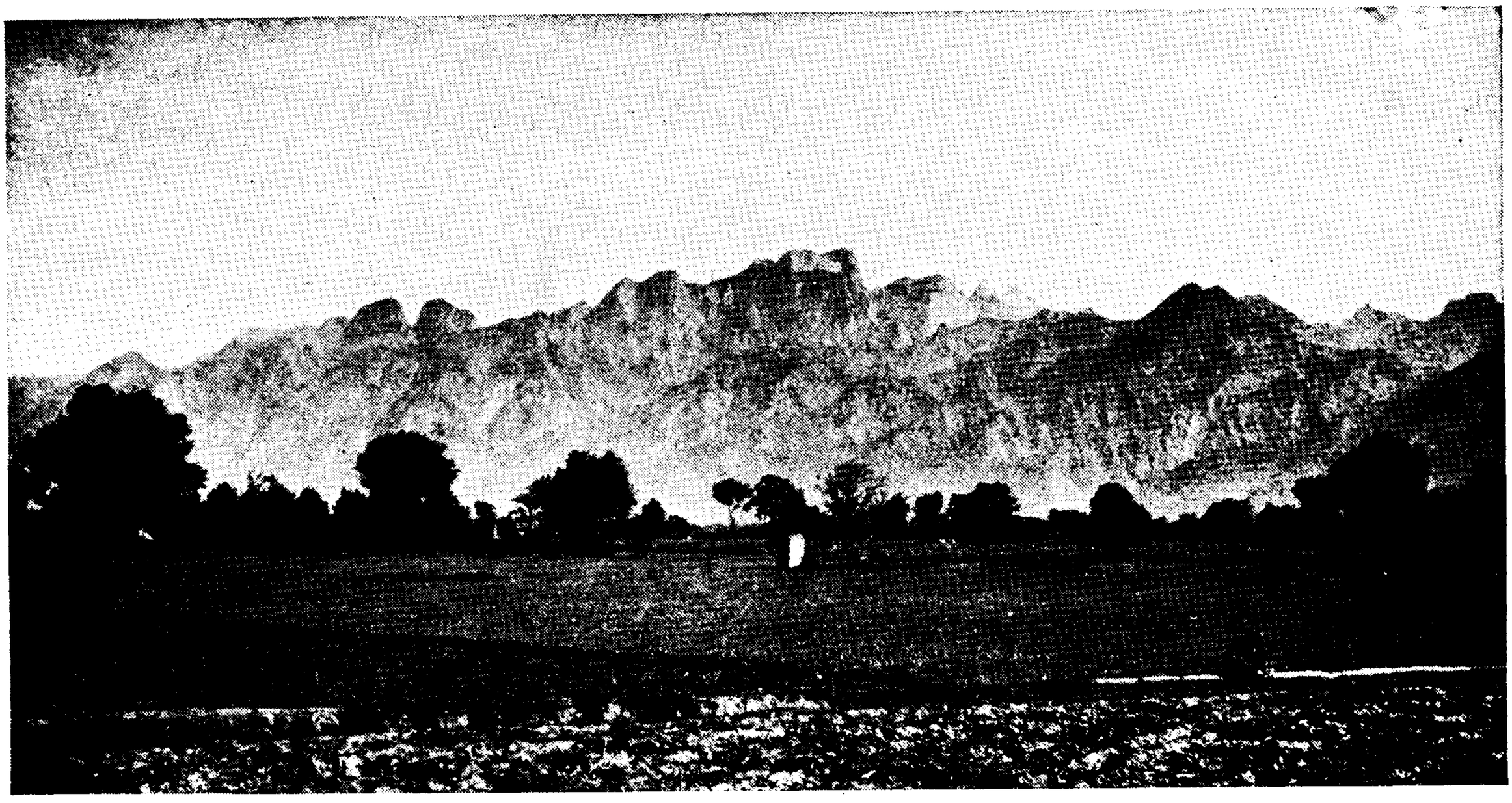

FIG. 14—Hwa Shan, the Sacred Mountain of the West, shortly after sunrise. It is situated south of the Wei River, in eastern Shensi.

northwestern Anhui, just south of the Hwai River and some three hundred miles northeast of its original location in what is now Hupeh province.

## CONSOLIDATION OF CHINA UNDER THE FIRST EMPEROR

Ch'in found time, in the course of this Hundred Years' War, to annex most of the Chinese states of the Hwang Ho valley. Ch'u was finally blotted out in 223 B. C., and two years later the last of the old Chinese states, that of Ch'i, in Shantung, shared its fate. This task accomplished, the ruler of Ch'in, who up to that time had held the comparatively modest rank of *Wang*, or king, consolidated his conquests, provided them with a centralized bureaucratic government, and himself assumed the title of Shih Hwang-ti[40] or First Sovereign Emperor. It is difficult not to see in all this the influence of the careers of Cyrus and Darius and Alexander, and perhaps

[40] "Hwang" here is an entirely different word from that which means "yellow," although spelt precisely like it in English; to the Chinese the difference in the characters makes the distinction clear enough.

too of Chandragupta and Asoka. Be that as it may, the work of Shih Hwang-ti was far more lasting than that of any of these. Probably no greater political genius ever lived. Certainly his achievement of knitting together a single empire out of such hostile and discordant elements so firmly that it still coheres after the stresses and storms of over two thousand years, is a feat never equaled by any other man.

Soon after his assumption of the new Imperial title Shih Hwang-ti undertook to add to his dominions the southern maritime regions, never hitherto effectively conquered by any of the civilized Powers farther north. For this purpose he gathered a vast army of soldier colonists numbering, it is said, half a million men. In this invasion the fullest possible use was made of the rivers, a simultaneous advance being made over five different routes. The principal of these seems to have been in part that followed by the railway now in process of building between Hankow and Canton. From the Tung-ting Lake it ascended the valley of the Siang River into what is now northeastern Kwangsi. At this point the great emperor had a canal dug to connect the waters of the Yangtze basin with those of the Cassia, a member of the great West River system. The invasion, like all else that the emperor undertook, was successful, and as long as he lived his power was acknowledged well down in what is now French Indo-China. After his death, however, his viceroy set up for himself, and it was not until nearly 100 B. C. that the South was again conquered for the Chinese Empire.

To the north and northwest, beyond the upper course of the Hwang Ho, conditions of a totally different order had to be met. Here was a semiarid region of boundless plains, inhabited by fierce horse-riding nomads[41] whom it was utterly impossible either to control or to exterminate. Shih Hwang-ti's policy toward these was one of exclusion and defense—a policy which found its most tangible and lasting expression in the building of the Great Wall by his orders.

With the establishment of the Ch'in Empire the history of ancient China comes to an end. The Ch'in Dynasty itself soon passed away; but its work has endured. Whatever political structure may finally be erected in China will perforce have to conform to the foundations so firmly laid by that great princely house of which the First Sovereign Emperor was the most illustrious, as he was almost the last, representative.

In another sense also the Ch'in period marks the end of an era. Up to that time it seems quite certain that all cultural elements from the civilized lands of the Occident had entered China by the upper waters of one or other of her two great rivers. But under the succeeding dynasty of the Han began that oversea intercourse with distant nations which has been going on ever since in steadily increasing volume until now it vastly exceeds in importance that carried on overland along the ancient trade routes up the valleys of the Hwang Ho and the Yangtze Kiang.

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[41] H. H. Howorth: The Northern Frontagers of China, *Journ. Royal Asiatic Soc.*, 1898, pp. 467–502; Fr. Hirth: The Ancient History of China to the End of the Chou Dynasty, New York, 1908, p. 67.

of the China of the Bronze Age will once more reassert themsequences to Siberia, to southeastern Asia, and to the world no one can as yet foresee.

# EXPLORATION IN THE LAND OF THE YURACARÉS, EASTERN BOLIVIA

By KIRTLEY F. MATHER
Denison University

League upon league of monotonous, water-soaked, jungle-covered plain densely forested; brown streams, gliding silently down winding channels, occasionally lashed into foam by giant snags, a deadly menace to the incautious canoeist; rarely, a tiny *chacra*, or clearing, with a dozen banana trees and a patch of yuca, a palm-thatched hut, and a dugout canoe—this is the land of the Yuracarés, an Indian tribe of eastern Bolivia. The land of the Yuracarés occupies the little-known southwestern corner of the vast Amazon Basin where there still exists many a "river of doubt" waiting the time when some adventurous explorer shall chart its tortuous pathway. Its rivers are all affluents of the mile-wide Mamoré, one of the larger heads of the Madeira which in turn is one of the largest of the tributaries to the Amazon.

This land is today crossed by one of the South American transcontinental routes of trade and travel, but as yet none of the published maps of Bolivia show its geography with even approximate accuracy. Travelers have hitherto confined their attention to the main thoroughfare; the adjacent regions have scarcely been explored. The accompanying map (Fig. 1), which is based on reconnaissance traverses with pocket compass amplified by information obtained from local inhabitants, is one of the first to portray the geography of this region with any attempt at accuracy.

The land of the Yuracarés is bordered on the southwest by the ramparts of the Andes, the successive steep-walled ridges of which effectively separate eastern Bolivia from the high plateau of comparatively populous western Bolivia. Across the Cochabamban section of the Andes there leads a single treacherous trail, significantly named "Sal Si Puedes" (pass if you can), whose hundred miles form the only difficult part of the transcontinental journey. From the upper end of this trail at the town of Cochabamba there is direct rail communication to the Pacific coast at Arica; from its lower end at Todos Santos there is more or less trustworthy connection by river steamers of varying dimensions and comforts all the way to the mouth of the Amazon at Pará. But in the land of the Yuracarés there are only two modes of transportation—on foot or in canoe.

## TODOS SANTOS AND THE RIO CHAPARÉ

My party of five, three gringos and two Bolivians, bent on exploring the upper reaches of the Rio Securé, reached Todos Santos on August 12,

# Compiled by Kirtley F. Mather
# 1921

SCALE 1:1,500,000

20 10 0 10 20 30 40 50 60 70 Kilometers

10 0 10 20 30 40 Miles

Route, Streams } Reconnaissance survey by K.F. Mather, Aug. 6 – Sept. 5, 1920

Streams } Sketched from data supplied by Colonel Román and Major Quintanillo, of the Bolivian Army and Wm. Henderson Engineer for the Cochabamba Light and Power Co.

Tiaboca

San Antoni

Porvenir

Puerto Calvimonte

800

RIO SECURÉ

850

Puerto Marquez

950

900

R. Isunota

R. Ibuasama

R. Bubusama

Plantota

Tayota

RIO ICHOA

RIO BOOMERANG

RIO MAMORÉ

R. Tiestota

R. Voporeta

RIO

R. Huesota

880

NORTHEAST MARGIN (APPROXIMATE POSITION) OF CORDILLERA ORIENTAL

MACHYA HILLS

Rio Moleza

ROMAN TRAIL

930

Rio Esasama

Rio Sesama

Puerto Patiño

920

R. Iguerezo

Rio Isinuta

Rio Ilubusio

R. Samuzebete

RIO

R. Isiisisama

Rio Ilubulito

RIO

Etéramasama

Namatamujo

CHIPIRIRI

R. Baibasama

CHAPARÉ

Misión de San Antonio

Todos Santos

R. Caraota

RIO

Crucero

1130

Machya

Junta

1530

2170

Rio Corani

Paracti

Rio Espiritu Santo

6100

Rio Palmar

R. San Antonio

ORIENTAL

Locotal

7730

Incachaca

Colomi

12780

12000

11130

Cuchicancha

Cochabamba

17°22'55" S.

66°04'18" W.

8900

Sacaba

Punata

Arani

Tarata

Cliza

1920, having crossed the mountains by the Cochabamba trail. Todos Santos is a little town of perhaps twenty houses built around three sides of a grassy square, the fourth side of which is open toward the Rio Chaparé. At this point the river is a hundred yards wide and flows between banks which during the dry season are twenty feet high but are awash during the rainy season extending from November to April. The port is at the head of navigation for a small wood-burning steamboat; but during times of low water this boat is frequently unable to ascend quite to the town and is then forced to transfer its cargo and passengers in small boats or canoes for the last few miles of the journey. Hides and alcohol from the cattle ranches and sugar plantations of the lowlands are shipped in considerable quantity up the Chaparé to Todos Santos and thence are transported on mule back to the markets on the plateau between the two ranges of the Andes. Cloth and other merchandise of foreign manufacture find their way from the Pacific coast across the mountains to this port and eventually reach consumers in the lowland towns and trading posts. Here, too, are the headquarters of the Batallón Zapadores, a part of the Corps of Engineers of the Bolivian army, which is at present doing valiant service exploring the jungles of northeastern Bolivia, cutting trails, building roads, and constructing bridges. It is less than a score of years since all this jungle was inhabited by *bárbaros;* yet today the machinery for a wireless station to be installed here is on its way from La Paz, and within a few months communication with the powerful radio station at Viachi will be open.

## The Mission of San Antonio

August 13, 1920, was a great day for the land of the Yuracarés, although no whisper of its importance has yet been echoed abroad. On that day the Zapadores completed the trail which connects the headwaters of the Chaparé with those of the Securé and permits for the first time the passage of the jungle into which it had hitherto been possible to penetrate only a mile or two from the navigable streams. It is planned to carry this trail on across the mountains to Cochabamba and thus provide a route over which cattle may be driven from the extensive pampas north of the Rio Securé—the grasslands of the Beni—to slaughterhouses in the cities on the plateau. This work is being prosecuted under the efficient leadership of Colonel Román, and in his honor the completed portion of the trail is named the "Román Trail" on the accompanying map. It had been our intention to reach our destination on the upper Securé by canoe, going down the Chaparé to the Mamoré and down it to the mouth of the Securé, but when the Colonel told us of his new trail we changed our plans and decided to take the shorter route overland.

This meant a walk of at least ten days through the jungle, for the trail is not yet in condition for mules or even burros—I doubt if it ever will be; and therefore it was necessary to hire Indian carriers to pack the essentials of our outfit on their backs. Accordingly, we arranged to have our trunks

and boxes shipped down the rivers to Trinidad, and three of us canoed downstream to the San Antonio mission in search of carriers.[1]

Distances along the rivers in the land of the Yuracarés are invariably reckoned by the number of meander curves in the stream's course: the mission is "five turns" below Todos Santos; it took us three hours to paddle down on Saturday afternoon and seven and a half hours to pole and paddle back upstream on Sunday. We arrived there just at dusk and received a cordial welcome from Padre Fulgencio Lasingor who had been busy all afternoon caring for one of the Indian lads on whom a tree had fallen the day before. The poor boy was in a very bad condition, with a broken collar bone and a compound fracture of the arm. Among his manifold duties the padre seems to find that of physician and surgeon to his flock the most irksome; I fear that his knowledge of medicine and surgery is not quite all that could be desired when serious accidents occur.

On the bank of the river, in the midst of a clearing of several acres, there are a dozen palm-thatched huts of bamboo, all but two of which are merely roofs supported by long poles. One of these two is of course the chapel, where everybody attended mass early Sunday morning; and the other, equally of course, is the padre's home, workshop, and office. Under one of the shelters two Indian women were preparing the evening meal over an open fire, and in a few minutes we were seated at a roughhewn red cedar table, whose beautifully grained top was concealed by a square of ancient oilcloth, eating *comida* with the padre and his two overseers.

I gathered from the conversation that the mission is somewhat more an agricultural project than a religious venture. It was first established in 1905, and the present padre has been in charge for eight years. Under his direction the Indians, of whom about fifty families are attached to the place, have cleared fifty or sixty acres of jungle and are cultivating sugar cane, chocolate, tobacco, rice, yuca, potatoes, etc. The soil is extremely fertile and very deep. Apparently all kinds of things, from onions to oranges, can be grown without difficulty. Only the crudest of agricultural methods are used; there are no modern implements or machinery of any sort; the juice of the sugar cane is fermented in a hollow log trough, and from it alcohol is distilled in a huge earthenware pot. But even this is a long step in advance for Indians who a few years ago were nomad savages subsisting on fish and game, with the soft heart of a particular palm tree and now and then a little yuca as their only vegetables.

## THE YURACARÉ INDIANS

The Yuracaré Indians are in the interesting transition stage between absolute savagery on the one hand and complete dependence upon white men on the other. Their territory is bordered on the southeast by that of the Sirionós, one of the wildest of Indian tribes in all South America. In

[1] For an account of the mission see also L. E. Miller: The Yuracaré Indians of Eastern Bolivia, *Geogr. Rev.*, Vol..4, 1917, pp. 450–464.

1913 a launch ascending the Rio Ichilo for exploratory purposes was forced to turn back because of attacks upon it made by these Indians, armed with poisoned arrows; and no attempt to explore that river has since been made. The Yuracarés seem never to have had the evil reputation of the Sirionós. Gibbon, who passed down the Chaparé, described them as "half friendly to the white man."[2] At the present time the Yuracarés are completely friendly and perfectly peaceable. As I came to know them in the intimate life of camp and trail, I found them to be most agreeable comrades, happy and jovial in times of difficulty and stress, unselfishly sharing with each other the game which because of the necessity for rapid travel we had no

FIG. 2—The Rio Eteramasama, looking upstream from the crossing of the Román Trail toward the Machya Hills, which may be seen in the distance at the right.

time to secure in large amounts, dividing their burdens with scrupulous exactitude, and always alert to minister to the comforts of the *caballeros*.

The Yuracarés still retain the marvelous ability of primitive peoples to utilize the rich resources of the tropical jungle. In the absence of matches the kindling of a fire by means of fire sticks is but the work of a minute; a hemispherical depression is hollowed in the side of a stick of soft dry wood, a short rod of a particular type of hardwood, held between the palms of the hands, is rotated rapidly in this hollow, the smoldering punk which quickly forms in the depression is blown into flame, and the fire is ready. Many of the men with us carried their bows and arrows; the bows are six feet long, fashioned from the tough dark wood which forms the core of the *chonta* tree, carefully tapered at either end, and fitted with strings made by twisting shreds of the inner bark of another of the many useful trees abounding in the jungle. Because of their resistance to water, these bark strings are preferable to the imported cord of foreign manufacture, which the

[2] W. L. Herndon and Lardner Gibbon: Exploration of the Valley of the Amazon, 2 parts, Washington, D. C., 1853–54; reference in Part 2, p. 190.

Yuracarés can now easily obtain. The arrows are about five feet in length and are of cane, tipped either with a slender lance of bamboo or a long, sharp, barbed point of ironwood. With these weapons the men kept themselves fairly well supplied with fish which they shot with remarkable dexterity in nearly every stream we crossed. Our camping places were usually the abandoned shelters of the workmen on the trail, but the night of our first *chancha*, or wild pig, hunt it was necessary to construct our own huts. Four Indians in less than half an hour cleared a space in the jungle and erected a palm-thatched shed, of ample dimensions for five beds, with an absolutely water-tight roof. Their ability as woodsmen is fully equaled

FIG. 3—The ferry canoe on the Rio Sesama. At the right is a portion of the sandy *playa* which appears at low water on the inside of each meander curve along the jungle streams. Beyond the canoe on the farther bank is a clearing for yuca cultivation.

by their expert knowledge of the rivers. The canoe in which I traveled for eleven days and for which I paid thirty bolivianos (about nine dollars) was thirty feet long and four feet wide, hollowed from a tree trunk and fashioned in graceful lines. With four paddlers near the bow and one steersman astern we navigated the treacherous waters of the Securé, going upstream for three days and downstream for eight, without even a moment of fearful suspense. Yet none of the men with me had ever before been on that river.

Most of my carriers wore shirts and trousers of foreign manufacture, but some were garbed in their aboriginal costume—a one-piece garment hanging from the shoulders and caught by a string around the waist, the whole made from the inner bark of the *bibbos* tree. This bark is peeled from the tree, pounded with wooden bludgeons, further softened by chewing, and dried. When properly prepared the "cloth" thus made is very tough and durable; when new it is quite white and is generally decorated with daubs of ocher; after repeated washings it becomes a brown drab; and this change generally takes place within a few weeks, for the Yuracarés are a very cleanly people. I offered to trade a pair of trousers and a shirt for one of these *curochis*

FIG. 4—The Rio Ichoa, showing two dugout canoes ferrying the Yuracaré carriers across the deep stream from the shelter at the crossing of the Román Trail.

with an old man whom I met on the Ichoa, but he asked me to pay him cash instead. When I gave him four bolivianos ($1.25) he was more than contented with his bargain.

Only two of our men understood Spanish; the rest knew nothing but their own Yuracaré dialect. Each little tribe in eastern Bolivia has its own language, and among the Yuracarés the advent of the Jesuit or Franciscan missionary has been too recent for the adults to have acquired proficiency in the language of the white man. This multiplicity of dialects in the lowland region attracts the attention of all travelers. It is in striking contrast to the widespread use of the Quechua tongue on the high plateau of the Andes. There, with the exception of Aymará-speaking sections of Bolivia, the one Indian language is known from Ecuador to Chile throughout the entire stretch of the ancient Inca Empire; but in the jungle the dialects are nearly as numerous as the rivers. As usual among primitive peoples, the vocabulary is very small and consists almost entirely of substantives and adjectives; verbs are seldom used; inflections and gestures count for much. If a Yuracaré wishes to say that there is water in a certain place, he merely says "Sama" with a nod of the head and a gesture to indicate the direction of the locality. If there is a plentiful supply of water there, he says "Sama-sama" in the same way.

## The Jungle Trail

The trail from Todos Santos to the Rio Securé is entirely in jungle country. For the most part the land is flat, lying at an altitude of approximately 1,000 feet above sea level; but between the Sesama and Ichoa Rivers a low divide is crossed, and the altitudes noted there were between 1,200 and 1,300 feet. The trail is a "slashing" through the dense tropical vegetation which keeps the ground in perpetual shadow. From Todos Santos to Crucero this slashing is thirty feet wide, and throughout most of that section the ground has been entirely cleared of stumps and projecting roots. Beyond Crucero the width of the clearing is only three or four feet, and not much care has been taken to grub out the snags along the pathway. Even in the dry season the ground is everywhere water-soaked, and in many places the mud is ankle-deep, with pools of stagnant water much deeper still. In the rainy season the whole must be an impassable quagmire, which undoubtedly renders the trail useless during those months. After the foot traveler has abandoned the notion of keeping his feet dry he has little trouble traversing this route, but 15 miles is a big day's march. Mules or burros, however, are absolutely useless; not because of the mud but because of the numerous small streams and arroyos which must be crossed. Every mile or so there is a watercourse, ten to thirty feet wide and five to fifteen feet deep, the bottom of which is a morass of mud and soft sand. Felled trees serve admirably as bridges for a man, but animals must inevitably "bog down" if they attempt to plunge through the quagmire. At the time of our visit to the region

bridges were being constructed between Todos Santos and Crucero, but the needed hundred bridges farther on had not yet been even planned. Furthermore, there is absolutely no forage for cattle, horses, or mules anywhere along the entire 125 miles (200 kilometers) of trail; the work of making a cattle drive had really scarcely begun.

The general trend of the Román Trail parallels that of the eastern Andes, the Cordillera Oriental. Looking westward up the more open courses of the larger streams encountered along the trail, the rugged ridges of that cordillera, rising to altitudes of 8,000 to 12,000 feet above sea level, may be seen among the clouds which constantly shadow the range. The foot of these mountains is about 25 miles distant from the trail, but the higher peaks are twice and thrice that distance. From three to five miles west of the trail, throughout much of its length, there is a line of low hills and ridges, 50 to 200 feet above their surroundings, which also holds the same general direction, curving northwestward south of the Isiboro River and then swinging a little more toward the north between the Ichoa and Securé. North of the Sesama the trail bends sharply westward, crosses through these hills, and holds its position in the low country between them and the mountains until, near the Ichoa, it crosses back again to their eastern side. Throughout its entire length the series of low hills is apparently separated from the mountains by a belt of lowland ten to twenty miles in width. I have named this line of hills and ridges the "Machya Hills," from the army camp of that name at the point where it is cut through by the Rio Chaparé. So far as I could observe them these hills are everywhere covered with jungle vegetation similar to that on either side. Major Quintanilla of the Zapadores informed me that in laying out the route for the trail he cut his way for several miles due north from a point near the mouth of the Rio Sesama and found the country so broken by ravines and hills that it was impracticable to extend the trail that way. In some of these ravines cliffs of solid rock bordered the watercourses, whereas along the trail as it now lies there is nothing but soil, sand, and muddy clay to be seen.

The jungle as we traversed it abounded in game of all sorts. Tracks of the jaguar and panther were frequently observed, and many an evening we heard the low rumble of their voices in the distance though we never caught sight of these crafty creatures. *Wasu*, the small, short-pronged deer of the jungle, and *chanchas*, the wild pigs or peccaries of the tropics, were however not so wise. The latter run in troops of a hundred and more. Our Indians were especially gifted in the art of locating their browsing places, and the excitement of bursting through the jungle into their midst was about the only thing that broke the monotony of day after day of tramping through the mud. Monkeys, large and small, black and red, chattered at us from the trees or fled pell-mell from branch to branch high above the ground as we approached. Macaws and parrots of many brilliant hues screeched a warning far in advance of our progress, and "turkeys," ranging in size up to

FIG. 5

FIG. 6

FIG. 5—Chimani Indians on the bank of the Rio Securé.
FIG. 6—A dugout canoe on the Rio Securé, manned by Yuracaré Indians.

the five or six pound *mutun* with his brilliant crimson comb in striking contrast to his glossy greenish-black body, burst heavily from the underbrush as we passed by. Snakes there were none, and humming birds hovered blithely about their nests where their eggs were safe from all depredations except those of the monkeys. But the list of wild animals would not be complete without a mention of the *mariwis* and mosquitoes. Of the latter very few of the fever-carrying variety are in this apparently healthful region. The former, which live by the million along the banks of every stream, are bloodthirsty insects about the size of a small gnat, endowed with the ability to raise a blood blister wherever they bite.

Between the Chaparé and the Securé the trail crosses a score of streams sufficiently large to be dignified by names. The more important of these are shown on the map. All are eastward-trending and have their sources on the eastern slopes of the Cordillera Oriental. The majority are only twenty to fifty feet wide and during the dry season are less than knee-deep. Typical of such is the Rio Eteramasama. A few are of much larger dimensions, and the traveler must cross them in canoe. The first of these which we encountered was the Rio Isiboro, named on some maps Rio D'Orbigny, because that traveler during his journey across eastern Bolivia in 1840 made a camp on its banks. No regular ferry canoe has yet been placed at the trail crossing of this stream, but this will probably be done soon. Except after heavy rains, however, it is only breast-deep and hence may be forded without danger. The day we reached it had been preceded by a night of tropical deluge, and it was a foot higher than ordinarily. Much care must be used in crossing such rivers as this, for the current is very swift and snags abound. A few miles downstream, the Isiboro receives the water of the Rio Sesama, a stream of equal size; and from that point downstream to the Securé it may be navigated at all times by fairly large canoes or during the rainy season by motor boats. The Sesama is only about a quarter of a mile from Puerto Patiño, and a ferry canoe for it is always close at hand.

Some miles to the north is the Rio Ichoa, another affluent of the Isiboro and quite appreciably larger than the Sesama. It is eight or ten feet deep and 200 feet wide; its waters are probably navigable by small motor boats for some distance upstream from the trail crossing. Canoes for crossing it may be obtained from the Indians living there. No other stream, until the Securé is reached, is large enough for anything but small canoes during the dry season nor available for motor boats even during the months of high water.

At convenient distances along the trail the Zapadores have constructed stockades for the impounding of cattle and large substantial huts for the shelter of passers-by, but at only three places did we find any permanent inhabitants. The first of these was beside the Eteramasama, where two or three families of Yuracarés have established themselves. The second was Puerto Patiño, where lives the *cholo* administrator of the vast estate of Señor Patiño, Bolivia's wealthiest citizen, who makes his permanent

residence in Europe. Of the thousands of leagues of this estate, only a few score acres surrounding the *finca* in the forks of the Isiboro and the Sesama are under cultivation. The dozen or so Indian peons on the estate have cleared the jungle and replaced it by fields of sugar cane, yuca, rice, bananas, cotton, etc., and groves of orange and lemon trees. Just enough has been done to indicate the wealth of agricultural possibilities which lies dormant in this expanse of unused lands. Farther along, on either bank of the Rio Ichoa, there are three or four Indian families living in miserable palm huts surrounded during the day by clouds of *mariwis* and infested at night by a

FIG. 7—Porvenir, the well kept *finca* of the sugar plantation and cattle ranch of Sr. Nestor Suarez on the banks of the Rio Securé.

nearly equal number of mosquitoes. Their homes are adjacent to tiny clearings where only yucas are grown between the tree stumps and logs. Similar conditions exist at Puerto Marquez on the Securé, except that here there is in addition one Bolivian family who keep a few chickens; and bananas as well as yuca are cultivated.

## THE RIO SECURÉ

We reached the banks of the Rio Securé at Puerto Marquez, obtained two canoes there, sent all but ten of our Indians back to the mission, provided the rest with paddles, and completed our wandering in the land of the Yuracarés by spending a week and a half on that river. First, we paddled upstream to the point where the river breaks through the Machya Hills; then we swept downstream with the swift current of the river to its mouth and on down the Mamoré to Trinidad—a succession of delightfully lazy

days after the vigorous toil of the jungle trails. Traveling upstream our canoes made only about two miles an hour, and once after traveling all day we found ourselves less than six miles in a straight line from the point where we had started in the morning, so tortuous is the course of the stream. Going downstream with the current the canoes averaged five or six miles an hour; it is generally fair to calculate that distances can be covered downstream in one-third the time required for the upstream journey.

The second night after leaving Puerto Marquez, going upstream, we camped on a sandy *playa* close to a small settlement of Chimani Indians, whose domain stretches northward from the Securé to the limits of the jungle. They were living in squalid palm shelters, about the size of a large dog house, where the women and children sat patiently brushing the *mariwis* from their faces and legs while the men fished in the teeming waters of the river or tended their tiny *chacras* of banana trees. The Chimanis never wear the bark *curochi* but have garments of the same style woven on crude looms from the native cotton. At this settlement they had quite a store of fish and bananas; our lads, though unable to converse in the Chimani tongue, were soon established on a friendly basis and made astonishing inroads upon the Chimani food supplies.

Throughout most of its course the Securé is bordered by banks of clay or sand, capped with six or eight feet of rich black soil, which rise abruptly from the water's edge to the level of the jungle-covered plain. At low water these banks are fifteen to twenty-five feet high, but in the rainy season the water spills over them and floods the ground between the trees which crowd close to the brink of the channel. Where the stream cuts through the Machya Hills, however, there is a shallow canyon with walls of maroon and carmine sandstone or vermilion and brownish-yellow shale. Between these walls the swift stream is lashed into foam at two points by gravel bars which prevent the upstream progress of all except small canoes. Our boatmen were able to ascend the first of these *cachuelas* by using poles, but at the second they had to leap into the water and half carry the canoe upstream. Between the Machya Hills at this point and the mountains, whose serrate peaks formed the distant western sky line, the lowland belt is ten or twelve miles in width.

The course of the Rio Securé is that typical of all streams in old age: extremely tortuous, with meander curve following meander curve in dizzy succession. Many times after paddling steadily around one such curve we found ourselves within a hundred yards or so of the place where we had been an hour before. The meander patterns are quite distinctive; the curve is not an arc of a circle, but is formed by short, sharp curves succeeded by comparatively straight stretches. Moreover, the dimensions of each meander seem to be a function of the stream's volume. The Tayota, the first important affluent downstream from Puerto Marquez, is not large enough appreciably to swell the waters of the master stream; but the Isiboro, which joins the Securé at Puerto Calvimonte, nearly doubles the volume. The meander

pattern immediately responds to this change in size of the river, and the length of the straight stretches between the turns is approximately doubled. Similarly, below the confluence of the Secuŕé with the Mamoré, there is another marked increase in the dimensions of the meanders corrésponding to the greater volume of water in the larger stream.

From Puerto Marquez to its mouth the Securé appeared to be quite safely navigable for motor boats drawing not more than two feet of water, even during the low stage in the river. At a few points there are snags which must be avoided, but these are not a serious obstruction to navigation. During the high water of December to May it should be perfectly feasible for small river steamers to ascend well beyond Puerto Marquez. At present, however, the river is very little used. Between the *chacras* of Señor Marquez and those of Señor Calvimonte, near the mouth of the Isiboro, the banks of the stream are lined with undisturbed jungle. Wild ducks flew up from the *playas* by the score; otters slipped from the logs along the bank where they were sunning themselves and sought safety in the brown water; river porpoises frolicked around our canoes; and occasionally a cayman drew his long snout down from off a snag and hid himself while we passed by. Once, we stopped and raided the jungle on our last *chancha* hunt in this region, the Indians having discovered in some uncanny way that a troop of peccaries was concealed near by.

Between the mouth of the Isiboro and the junction of the Securé with the Mamoré, the Securé flows close to the southern boundary of the extensive grassy plains which stretch far to the northward until the rubber forests of northernmost Bolivia are reached. On these open pampas there are many large cattle ranches. One of these, owned by Señor Nestor Suarez, has its main *finca* at Porvenir on the north bank of the Securé. This is a typical Bolivian lowlands country estate with its wooden cane press and primitive sugar refinery. It was the first outpost of modern civilization we encountered since we left Todos Santos. We spent one night there, and the second day following, as we were proceeding down the Mamoré below the mouth of the Securé, we met another sign that we were leaving behind us the wilderness of the land of the Yuracarés. This was the *Ana Catarina*, the small steamboat which plies the rivers between Trinidad and Todos Santos, chugging patiently upstream on its monthly journey. Before night we had reached the port close to Trinidad, and our wanderings in the land of the Yuracarés were ended.

It is a land of wonderful opportunity, a land of great natural resources, where untold agricultural possibilities lie dormant. These jungles are susceptible of transformation into rich plantations whence can be made an important contribution to the food supply of the world. But this transformation can never be wrought by the present inhabitants of that land. The Indian inhabitants lack the ability to work without constant supervision; their intelligence is not sufficient to permit them to rise much above their present estate. Nor does it seem likely that this transformation will

be wrought by the present white population of Bolivia. Their handicap is of quite a different sort, for they are in no way lacking in intelligence or ability. Their trouble is that they have not learned the dignity of labor. For generations they have been schooled in the principles that a workingman is low caste, that only Indians and *cholos* are expected to undertake manual labor. They are born to be lawyers, army officers, politicians, and land-owners; farmers and craftsmen, never. And the combination is utterly failing to utilize the resources beyond the frontiers of civilization in Bolivia. The land of the Yuracarés will remain a jungle until a people who combine the will to work with a high order of intelligence enter it and transform it into the important food center that it may become.

# NOTES ON THE FORESTS OF SOUTHEASTERN LABRADOR*

By E. M. KINDLE
Geological Survey of Canada

One who has seen only the barren eastern coast of Labrador might expect a discussion of Labrador forests to rival in brevity the famous chapter on the snakes of Ireland. A cruise along the coast brings before the traveler a shore line which appears to belong to one of the most barren and treeless lands in the world. When viewing it from a distance the traveler is likely to acquiesce in Jacques Cartier's description of Labrador as "the land that God gave Cain." A short journey up any of the rivers which reach the coast of southeastern Labrador, however, will take the explorer into a densely wooded country which has no resemblance to the barren coast line and will convince him of the injustice of this description.

The coastal strip and the interior present surprising climatic contrasts which are most clearly reflected in the distribution of the forests. In passing through the Strait of Belle Isle in July a stream of floating ice and bergs is met with, which increases in volume as one proceeds up the coast. Throughout most of the month of July the vast ice fields move steadily southward under the influence of the Labrador Current, past a bleak rocky coast on which no timber can be seen (Fig. 2). The sub-Arctic climate which the southward-moving ice fields bring as far south as the Strait of Belle Isle extends but a short distance inland from the coast. In crossing the eastern threshold of the peninsula by way of Lake Melville and the "Narrows" one finds that there are two Labradors. One is a narrow coastal zone of islands and sea-facing mainland, called "the Labrador" by the cod fisherman, which is chilled by ice floes and is nearly or quite treeless. Inside this seashore strip is the heavily forested vast interior Labrador, traversed by countless streams and dotted with thousands of lakes. In this interior region salmon and trout fishing take the place of cod fishing. A summer climate replaces the ice-chilled coastal climate, and forests cover both mountains and valleys.

The observations along the coast line here recorded were made chiefly from the decks of the Newfoundland steamers, which call at the numerous fishing stations on the Labrador coast, and during a cruise on the S.S. *Acadia* to Rigolet at the entrance to Lake Melville. My earlier impressions of the coast were obtained from the deck of a sealing steamer during a cruise to the Arctic. The notes relating to the interior are based on a launch-and-

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canoe trip covering a few hundred miles of the lakes and rivers of the Lake Melville district in southeastern Labrador (Fig. 1).

## The Coast Line

The route traversed in going north last season (1921) included a stop at the Bay of Seven Islands near the head of the Gulf of St. Lawrence. The heavy forests which reach the shore line at this point are being utilized by one of the largest pulp mills in Canada. The product of this mill goes to the Northcliffe papers in England.

From the intense heat of early July at the Bay of Seven Islands a short run brought the *Acadia* into the ice-cooled breezes of the Strait of Belle Isle. The first patches of snow were seen ashore near Mekatina Island on July 10. Ice fields, dotted occasionally with large bergs, were constantly alongside after we entered the Strait (Fig. 3).

With the appearance of ice on the sea comes the disappearance of forests on the shore. Bare rocky slopes without timber form the background of the southward-moving procession of bergs and floe ice.

An endless variety of shapes are represented by the icebergs. Some, as a result of irregular melting on the surface, show a crater-shaped top filled with fresh water; others have sharp pinnacles and mountain-like outlines; still others have a slightly modified tabular outline. Occasionally a berg shows a huge arch running through it, representing probably a section of a glacier which has been carved by a subglacial stream. The general color of the bergs is the purest of white, but many show a fine delicate shade of green. A few have seams of bluish green ice running through the pure white of the main mass. Some observers are impressed by the architectural suggestion conveyed by icebergs. Cabot says that "Man's architecture in all its forms is hinted at, and often the forms of living creatures, natural or grotesque; but the spirit of the ice is mainly architectural: the gods of the North had their temples, and these are their fragments."

Under a clear sky the ice floes present a striking scene. The sun is reflected from thousands of cakes of floe ice of every conceivable shape, ranging in size from a few square feet to acres of surface and extending to the sky line a dazzling field of white. Probably no other coast line shows more striking and novel mirage effects than that of Labrador. The mirage often repeats the floe inverted. Sometimes the sharp-pinnacled bergs have resting upon them their duplicates inverted, the columns and pinnacles coalescing. At the horizon the mirage often gives the appearance of a solid vertical wall of ice encircling the ship.

The distorting effect of the mirage on the low rocky islands is very interesting and remarkable (Fig. 4). The White Bear Islands and many others along the coast are low, bare, rounded masses of rock. Under the magic influence of the mirage these are made to caricature all kinds of topography.

The mirage lifts up the insignificant ice-rounded hills into vertical-faced

cliffs presenting at times a vertical unbroken front of flat-topped cliffs for miles. At other times the low rocky points on the shore rise up as pillars of brown or gray rock, and these will spread out into gigantic mushrooms

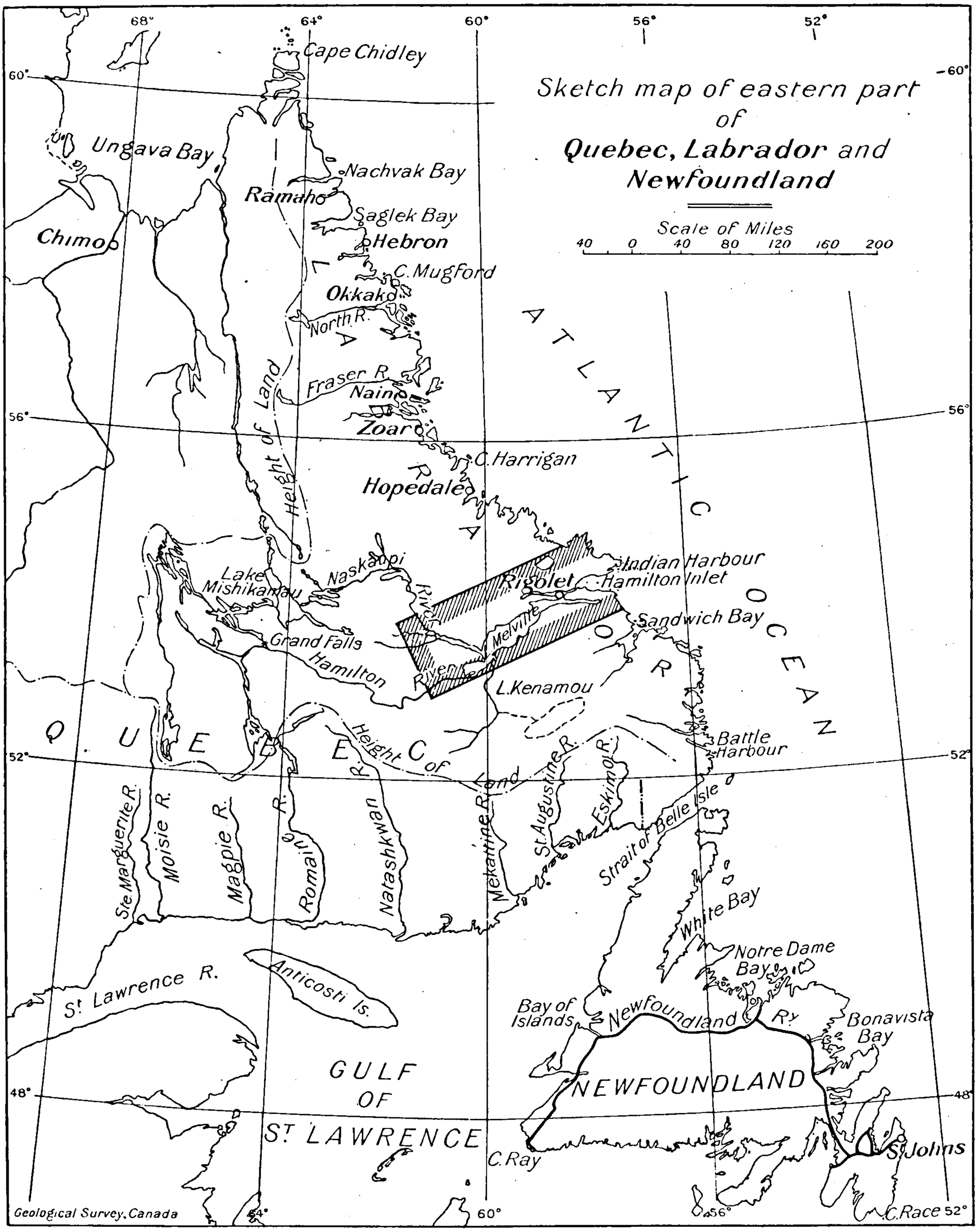


FIG. 1—Sketch map of eastern Labrador.

with flat, pancake-like tops. The most common form produced by the mirage is the flat-topped mesa. But no form persists long, one type dissolving into another or giving way temporarily to the real aspect of the shore line. As one watches lofty vertical cliffs, sharply defined, rising from a low, barely visible shore, then melting away at the summits, and presently vanishing altogether, it is easy to imagine some invisible magician of the

deep, with age-long memories of the past, exhibiting some of the episodes in Labrador's geological history.

The bleak, time-eaten, rocky shores of the islands and mainland, to which the mirage gives such a variety of aspects, continue barren of trees, with a few trifling exceptions, from the western end of the Strait of Belle Isle to the vicinity of Sandwich Bay. An island in this vicinity with a few straggling spruces near the summit gave me the first hint that trees are to be found in Labrador. Other islands were seen in or near Sandwich Bay which had considerable patches of black spruce on shores which did not face the open sea. In general, however, forests are either absent on the seacoast or confined to the sides of ravines or small valleys where the topography affords some protection to timber.

## Hamilton Inlet

Probably nowhere on the coast of Labrador can the transition from the barren outer islands to the forested interior be better seen than in Hamilton Inlet. This bay has a length of about 40 miles in an east-and-west direction and is dotted with numerous rocky islands. The eastern, or outermost, of these are clothed only with lichens, emerald green moss, and a considerable variety of flowering plants. Trees are entirely absent if we except a variety of arctic willow and a dwarfed birch which grow prostrate upon the ground, their branches seldom rising more than two or three inches above the rock crevices that protect their roots.

Fifteen miles to the westward the shores of the mainland and the islands begin to show patches of black spruce of a dwarfed type (Fig. 5). These show at a distance on the hill slopes as blotches of dark green on the light green of the moss-covered surrounding areas. The stunted spruce becomes somewhat larger, and the areas covered by it more extensive, as the head of the inlet is approached.

It is clear that the climatic condition resulting from floating ice is the main factor keeping the outer shores deforested. Great fields of ice persist in the outer parts of the Inlet till the latter part of July. Scattering ice cakes were seen 18 miles west of Indian Harbour near the extreme outer end of the Inlet on August 20. The ice, however, is seldom if ever seen in midsummer within many miles of Rigolet, which is situated near the head of the Inlet. Around this ice-free part of the Inlet the forests clothe a large part of the land surface; and the trees, though small, make up dense forests.

## The Interior

After becoming familiar with the dwarfed spruce forests along the shores about the head of Hamilton Inlet, with trees 15 to 35 feet high, one is hardly prepared for the great change in their character which occurs in the area around Lake Melville, lying just west of the head of Hamilton Inlet. At Rigolet the visitor may see squared timbers used for hauling out vessels that would be considered creditable representatives of any Canadian forest.

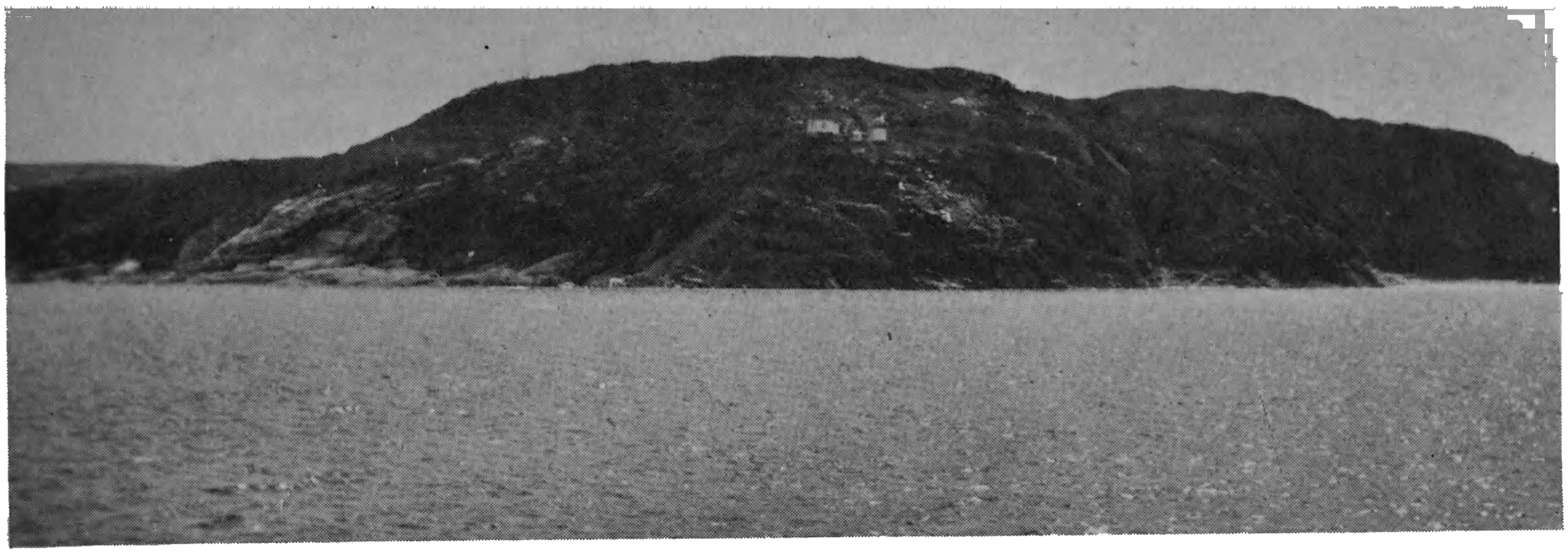

FIG. 2

FIG. 3

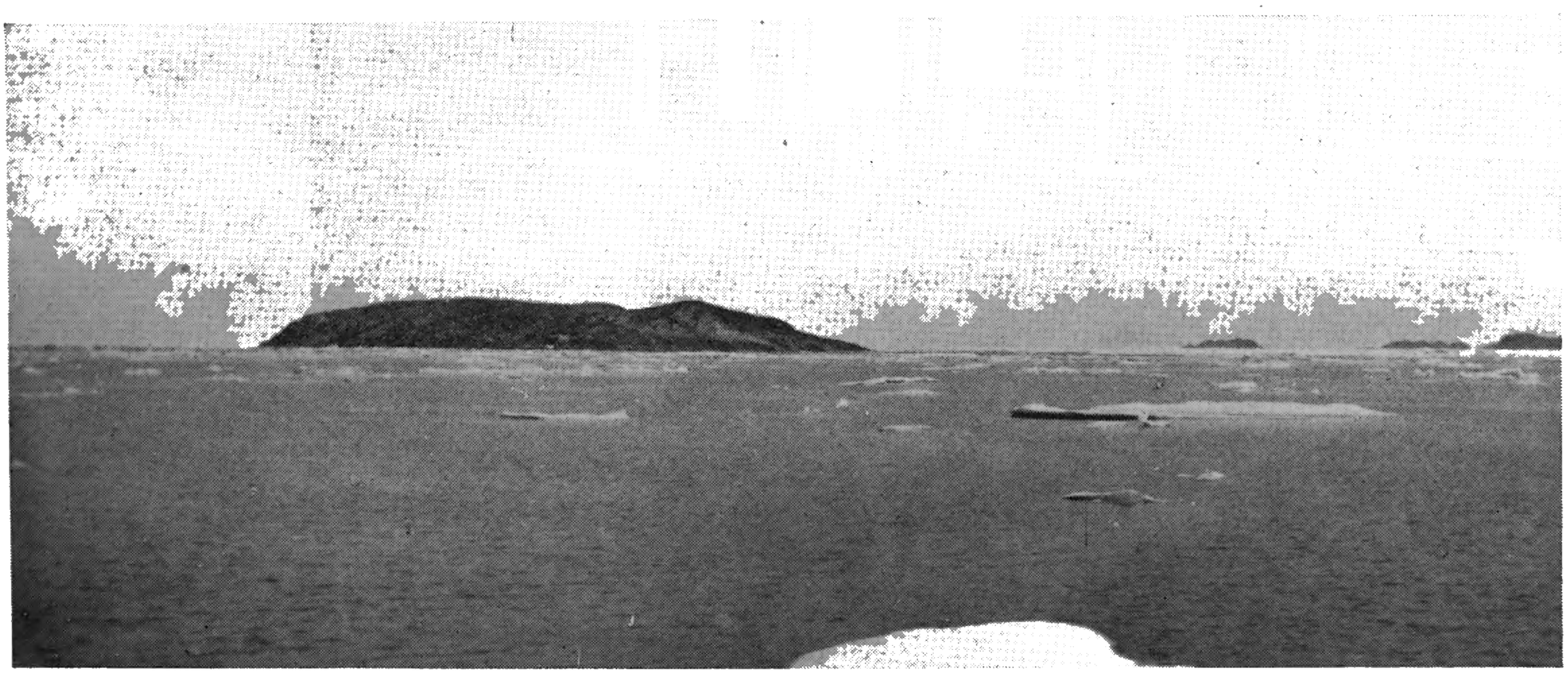

FIG. 4

FIG. 2—A typical view of the treeless shore zone on "the Labrador." Note the houses high up the slopes.

FIG. 3—View from the bridge of the S.S. *Acadia*, taken in July, showing floe ice and patches of snow on Labrador hills.

FIG. 4—Low islands on the Labrador coast surrounded by ice floes in July. The shores assume many fantastic and astonishing shapes under the influence of the mirage.

One of these was measured by the writer. The figures are: length, 59 feet, butt dimensions, 1 foot 4 inches by 9 inches; dimensions at small end, 9½ by 6½ inches. This piece of timber, which was cut near the head of the lake, is considerably larger than any timber near the seashore.

Black spruce (*Picea mariana*) is the dominant tree throughout the Lake Melville district (Fig. 5), but white spruce becomes increasingly common as one proceeds inland. The white birch (*Betula pendula*) is a very common tree, and in tracts which have been burned over it has taken possession of the ground to the exclusion of all other trees. The largest specimens of the birch observed, however, were seen where they occurred sparingly in forests of black and white spruce.

Where the birch constitutes the whole of the forest, as it often does over tracts which have been burned, its light green foliage distinguishes it at considerable distances from the darker evergreen forests. The forest color effects vary greatly with the illumination and the distance from the observer. Under a gray sky the black spruce forests are nearly black in the middle distance, dark green in the foreground, shading off into deep dark blue in the distance. Under a half-clouded sky the forested mountain slopes are marked with blotches of dark blue on a field of light green, the color scheme changing constantly with the shifting of the clouds. Sometimes at the finish of a shower a spruce-covered island, rainbow-arched, will furnish a picture not easily forgotten. Labrador has been described as the land of rainbows; the dozen or more daily showers often experienced during the past summer seem to justify the title.

In many places in the Labrador forest the ground is mantled by a carpet of sphagnum moss into which one sinks to the knees. When this is absent caribou moss often replaces it. Where the trees are not too closely spaced the ashen gray of the caribou moss gives a color contrast to the dark green of the black spruce visible at a considerable distance. Nearly everywhere the white blossom of the Labrador tea is seen during July. As its blossoms fade the dark pink lambkill takes its place, decorating the woods with a profusion of delicate color throughout the latter part of the summer. About the first of August the half-ripe low-bush cranberries begin to show rosy cheeks above the moss, and a little later the rich dark purple bear-berries and blueberries spread a feast of delicious fruit and ravishing color on the gray rocky summit of every hill and mountain. The wild currant, the crowberry, and the baked-apple are among the other refreshments which the forests set before their visitors. Alder and willow generally form the forest border along the streams. The fragrant-leaved sweet gale is also frequently seen about the margin of the forests.

The principal trees in the approximate order of their abundance in the Lake Melville district are: black spruce (*Picea mariana*, B. S. P.); white, or canoe, birch (*Betula pendula* Roth, var. ?); tamarack (*Larix laricina*, Koch); fir (*Abies balsamea*, Mill.); white spruce (*Picea canadensis*, B. S. P.); balsam poplar (*Populus balsamifera*, L.); yellow, or gray, birch (*Betula*

*lutea*, Michx. f.); black, or white, birch (*Betula lenta*, L.); trembling poplar, or aspen (*Populus tremuloides*, Michx.); ground juniper (*Juniperus communis*, L., var. *depressa*, Pursh.).

The fir, white spruce, and black spruce are the trees which have been used for lumber in the region. Both the white and the black spruce reach a large size in many localities. The following figures indicate the character of some of the larger trees in these Labrador forests. On Mulligan River a black spruce measured 5 feet 6 inches in circumference 20 inches above the ground. Another black spruce on the Kenemich River measured 9 feet 10

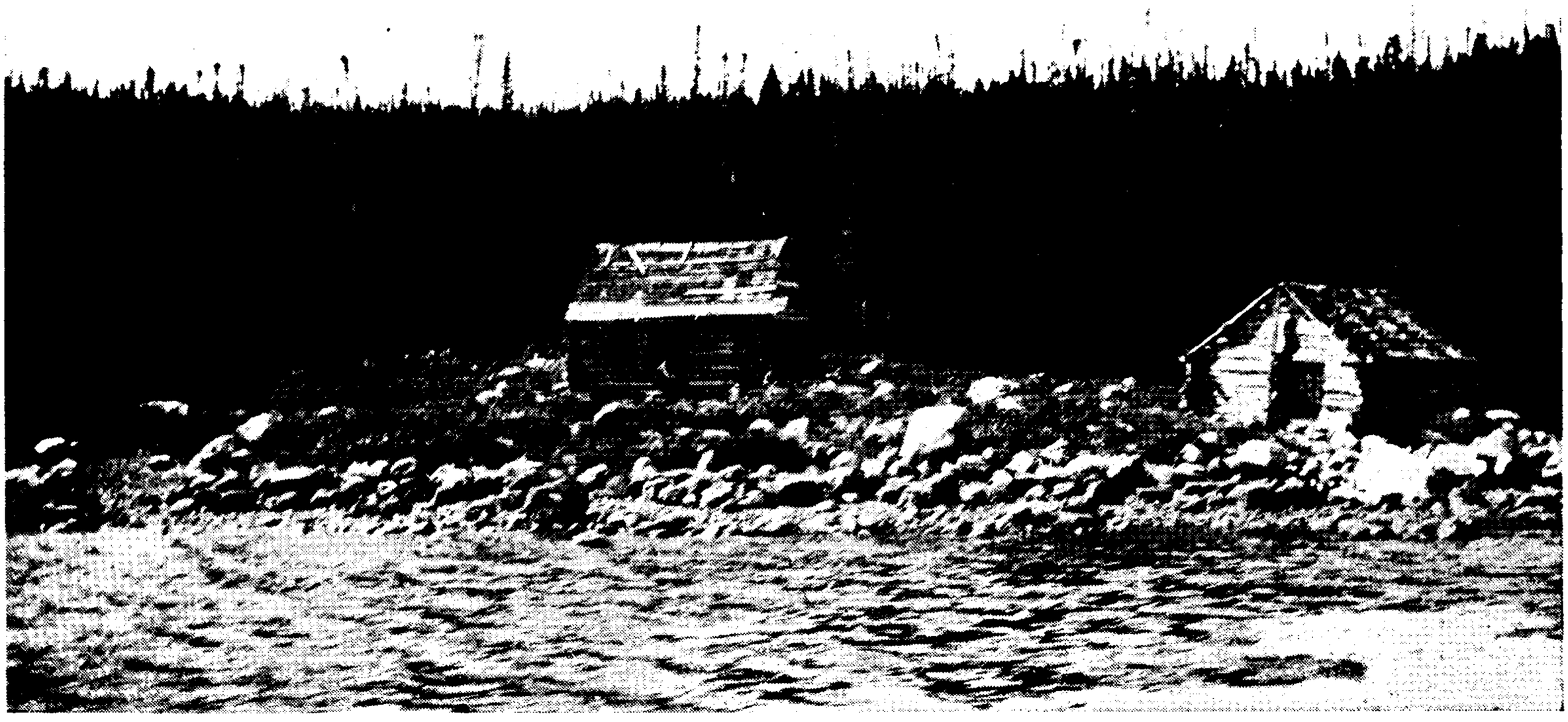

FIG. 5—Black spruce forest near the eastern end of Lake Melville, Labrador. Much larger timber is found farther from the seacoast.

inches in circumference: its fine straight trunk appeared to be 100 feet high. The black spruce here probably reaches a greater average size than in Nova Scotia. At the head of Grand Lake a spruce in the driftwood had a diameter of 25 inches. A white birch on the Kenemich measured 5 feet 1 inch in circumference. These figures represent a few of the largest trees seen, but many others nearly or quite as large were observed. A large proportion of the forest trees approach these figures closely enough to furnish a large supply of logs suitable for lumber. The mountain slopes carry vast quantities of smaller timber which will no doubt be used eventually for pulpwood.

Two large sawmills were started in the district several years ago. One of these is near the mouth of the Grand River; the other is at Carter's Basin. They have not been in operation during recent years, but this is not from any lack of good timber. At present only one small mill, with portable gasoline engine, is in operation (Fig. 8); it furnishes lumber for local use.

It may be noted here that this region is nearer the British and European market than is any part of the Maritime Provinces.

The shores of Lake Melville are bordered by a considerable area of relatively flat or slightly rolling land on which the best timber is found. This area extends up the Grand River to Muskrat Falls, 25 miles above the mouth, and beyond (Fig. 6). On the mountain slopes much smaller trees occur.

Grand Lake, which lies northwest of Lake Melville and empties its waters into it, is without any lowland border, the mountains descending precipitously on the west and by gentle slopes on the east. This lake, which is about 30 miles long, was traversed in rainy weather when the forest-clad hills appeared and disappeared like huge gray ghosts through the foglike canopy which hung over the lake. At Cape Blanc, which is a steep-sided mountain rising abruptly from the lake, the scars of old avalanches are plainly visible. In some of these the timber and soil have both been stripped completely from the mountain face. In others in the midst of a black spruce forest, a belt of birch bounded sharply by perfectly straight lines tells the story of an old avalanche.

On the Nascaupee River and the Red River the broad sand-and-clay terraces support a better forest growth than the Grand Lake basin. My own observations in this valley extended up to its junction with the Red River and a day's journey up the Red. Mrs. Leonidas Hubbard, who traversed the entire length of the Nascaupee, reports one of the trees seen to have a circumference of nine feet. She states that "the valley is mostly well wooded with spruce and balsam as far as Mabelle Island, and here the spruce reaches splendid size."[1]

Bryant and Turner have explored parts of the region south of the Lake Melville basin which my expedition did not enter. The rivers traversed by them enter the Gulf of St. Lawrence between the Mingan Islands and the Strait of Belle Isle. Townsend writes of the timber along the Natashquan valley, nearly opposite the eastern end of Anticosti, as follows.

> The forest trees gradually increase in size from the coast where in places, as on the plateau back of the little village of Natashquan, they are nearly prostrate, to this point where they appear to have reached about their maximum and attain a height of 50 or 60 feet. Black spruce and balsam fir are the predominating trees, but white spruce are not uncommon. White birches are scattered here and there and often form pale green patches in a sea of dark spruces and show where a fire has swept through. Mountain ashes are few and far between as well as aspens, but, on the borders of the river, alders and dwarf willows are common. Of larches only a few remnants are left of this once abundant tree. Some years ago a devastating worm—the larva of a sawfly—swept through the country, and the larches were nearly exterminated. At Rigolette on Hamilton Inlet I had seen in 1906 the larches covered with these worms. Fortunately in this region of the Natashquan, at least, there are enough scattered veteran larches left to perpetuate the race, and vigorous seedlings are growing up, and I saw nothing of the worm.
>
> The largest balsam fir I measured at this place close to the 5th Falls was 64 inches in circumference three feet from the ground. A black spruce was 43 inches, a white birch

[1] *Bull. Amer. Geogr. Soc.*, Vol. 38, 1906, p. 533.

was 72 inches. The white birches are rough and lichen-stained—gray and green and black—and the bark peels off in great rolls and hangs all over the trunk in rags.[2]

The observation of Townsend that the trees on the Gulf coast can survive only as prostrate dwarfs corresponds with the conditions which may be observed further east and north.

The St. Augustine River, which enters the Gulf of St. Lawrence 150 miles east of the Natashquan River, was ascended to the Height of Land in 1912 by Henry G. Bryant. Concerning the forests observed on this expedition Bryant writes as follows.

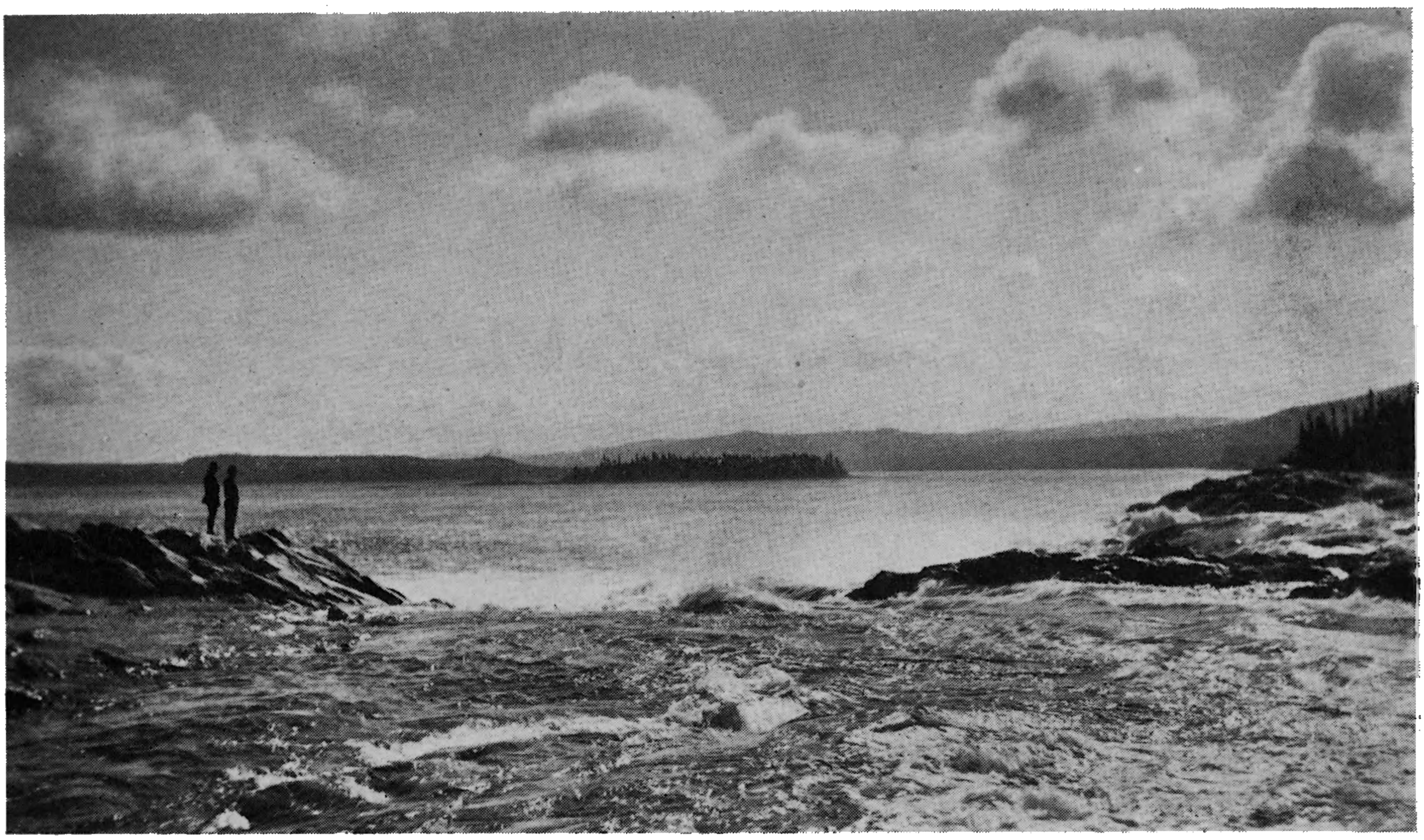

FIG. 6—View looking down Grand River from Muskrat Falls.

Referring to the timber resources of the region traversed, it may be of interest to mention that for the first twenty-five miles above the mouth the hills rising from the broad valley of the river are covered with a thick mantle of firs and spruces of small size and growing in the close formation so characteristic of the Laurentide landscape. These growths of the lower valley are suitable for pulp manufacture but, aside from this, possess little commercial value. For the next twenty-five miles to the vicinity of the first falls the size of the two varieties mentioned improves, and many scattered groves of birches are observed. Beyond this for about twenty miles a noticeable increase in size and quality of the spruces is apparent, while the firs have become a less important element in the forestation. While the best timber is not continuous here, many tracts may be seen containing trees which measure, three feet from the ground, something over two feet in diameter. . . .

In the neighborhood of the Height of Land the country is more open, while the tops of the ridges are often quite bare. Some of the finest spruce timber encountered on the journey was found in small groves in sheltered localities within a few miles of the lake sources of the river.[3]

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[2] C. W. Townsend: A Short Trip into the Labrador Peninsula by Way of the Natashquan River, *Bull. Geogr. Soc. of Philadelphia*, Vol. 11, 1913, pp. 170–182; reference on p. 175.

[3] H. G. Bryant: An Exploration in Southeastern Labrador, *Bull. Geogr. Soc. of Philadelphia*, Vol. 11, 1913, pp. 1–15; reference on pp. 13–14.

The Labrador and Alaska peninsulas on opposite sides of the continent are nearly equal in size and are in some degree comparable in the distribution of their forests. A large part of the Labrador shore line, like that of Alaska, is barren of forests. In both peninsulas the barren zone is widest along the northern shore line. In Alaska the barren shores of Seward Peninsula are replaced along the coast to the southeast by the heavy forests of southeastern Alaska and British Columbia. The wide barren zone of northern

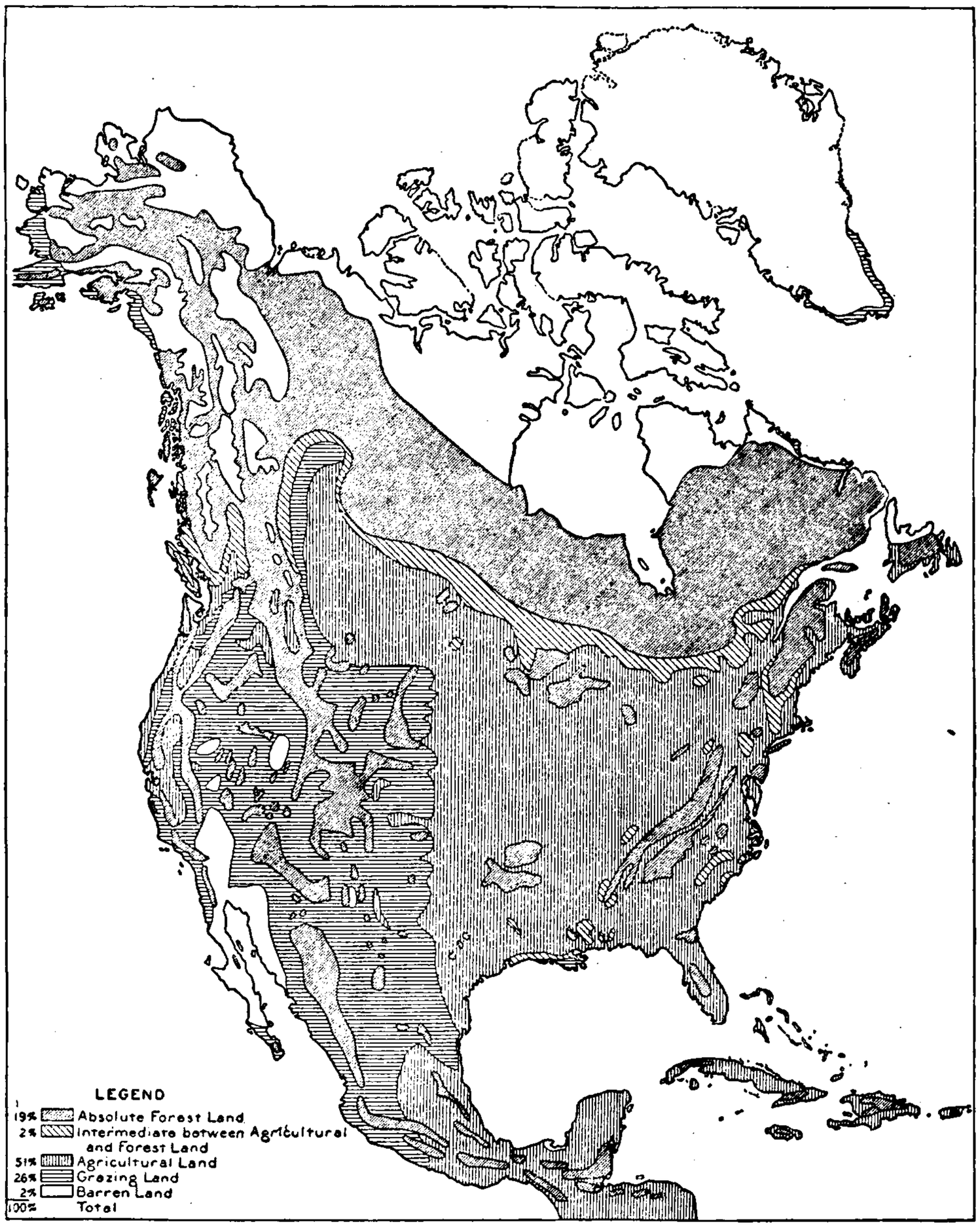


FIG. 7—Probable future land classification of North America. (After Raphael Zon with modifications in eastern Labrador by E. M. Kindle.)

Labrador and the relatively narrow barren zone of eastern and southeastern Labrador give way in like manner toward the southwest to the spruce forests of the St. Lawrence River.

Examination of the accompanying map of the distribution of North American forests will show the very important rôle which Labrador will probably play in supplying forest products for the world market of the future. The Lake Melville waterways are of peculiar importance in this connection because they afford about 200 miles of navigable waters which are usable by seagoing vessels. These waterways include Lake Melville, Grand Lake, Double Mare, and Back Way. This penetration of the heart

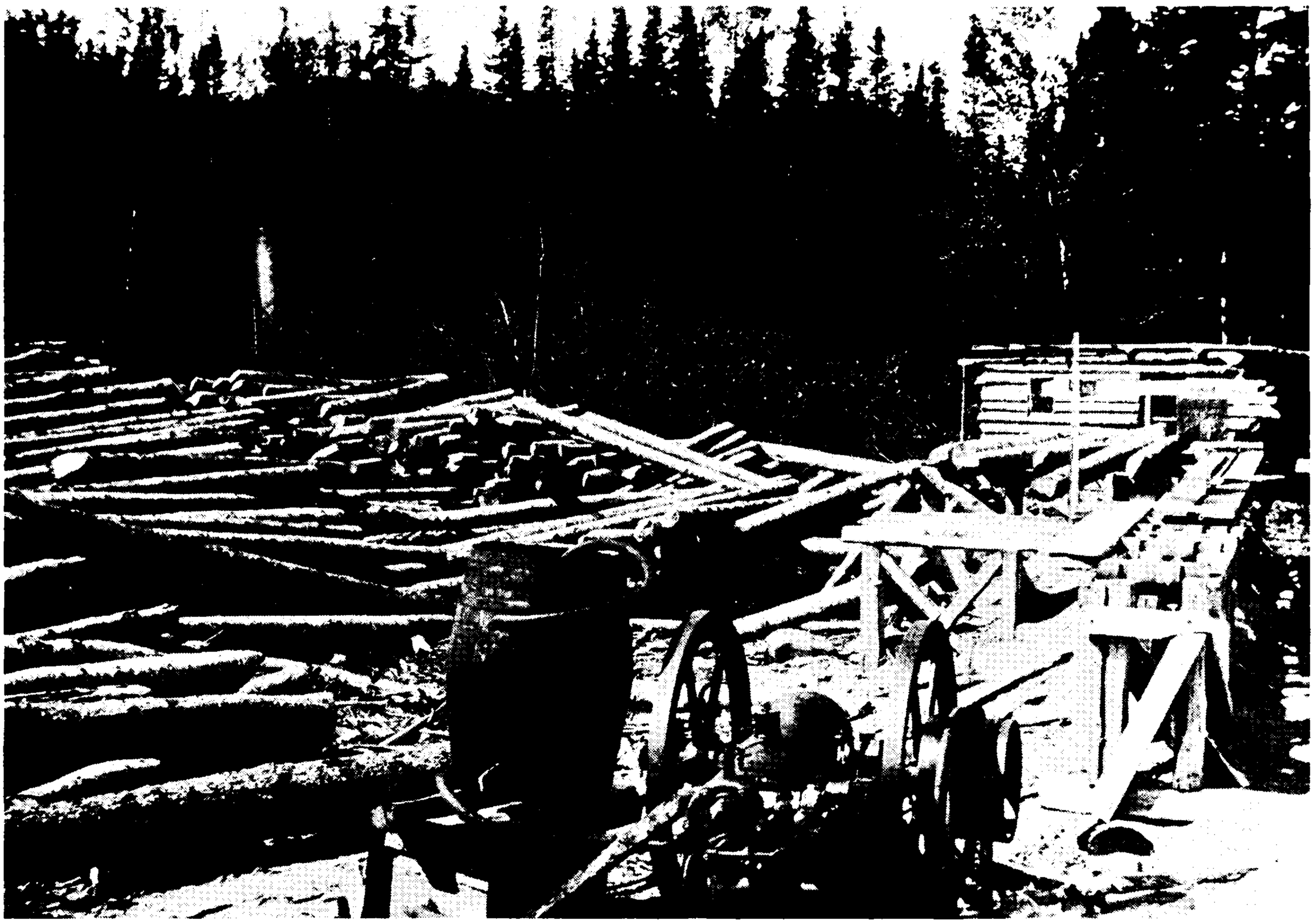

FIG. 8

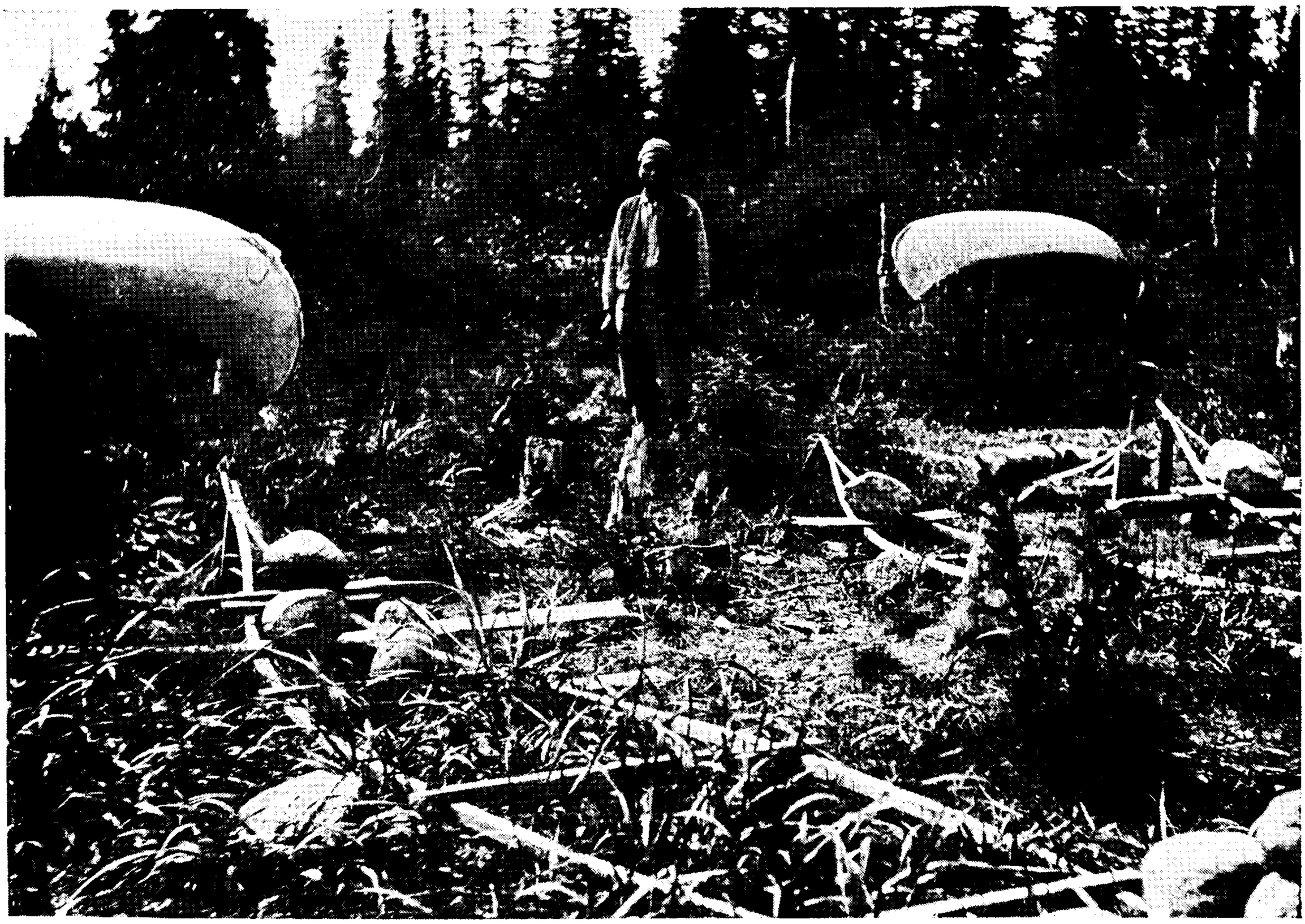

FIG. 9

FIG. 8—Sawmill on English River, Lake Melville.
FIG. 9—Indian canoe factory in the forest at Northwest River.

of the best of the Labrador forests by deep waterways must become an important element in keeping transportation costs at a low figure.

Canada is destined by its geological and geographical features to remain permanently the great forest country of North America. Compared with the area of the great forest belt extending from the Labrador coast to the Pacific, the widely scattered forest areas to the south of it appear insignificant in size (See Fig. 7). Lake Melville may reasonably be expected to become in the future one of the important eastern outlets for the forest products of the eastern portion of this vast forest zone.

## Forest By-Products

The forests of the Lake Melville region remain practically untouched. Lumber and other ordinary forest products, except as already noted, are not

Fig. 10—Eskimo family near the western end of Hamilton Inlet. The sparse forest seen at the left represents the dwarfed type of spruce commonly found near the eastern seaward limit of the forested zone.

at present produced in the Lake Melville region. The single portable mill now in operation supplies lumber only for local use, and much of this is still cut with the old hand whipsaws. Until the boundary question is settled and it is known whether Newfoundland or Canada has authority to grant timber concessions, it is not likely that any large attempt at timber or pulpwood production will be undertaken.

At present the forests supply only by-products in the shape of fur-bearing animals. In one sense the annual fur catch may be regarded as a forest by-product. The heavy forests produce what is said to be the finest grade of fur known in the north. The fur-bearing animals and the people of the region are both, strictly speaking, forest products since neither could exist in the region without the forests.

Minks, weasels, and martens are the more common fur-producing animals. Red, cross, silver, and white foxes are trapped—the last generally being found only near the coast. The otter, lynx, and beaver are also present.

This region is near the southern limit of the range of the polar bear, which is sometimes taken on the seacoast; but it, like the seal, belongs to the sea rather than to the forests.

Originally the region was divided between the Indian and the Eskimo. The latter is nearly extinct in the Hamilton Inlet region and southward. The Eskimo held the narrow seacoast strip—approximately the same narrow shore zone now occupied by the Newfoundland fisherman—while all the vast interior river and lake region belonged to the Indian. When either race overstepped the time-hallowed boundary between them, savage reprisals resulted. Battle Harbour is one of the names which has survived from the days when the Indian and Eskimo tried to revise the Labrador boundary with the tomahawk and the spear. From the region south of Hamilton Inlet the Eskimo has disappeared, and the Newfoundland

FIG. 11—Indians preparing evening meal at NorthWest River.

fisherman has taken his place. The Indian still survives but lives as his ancestors did, except that canvas canoes and tents have supplanted the birch-bark canoe and the skin-covered tepee.

## EVOLUTION OF THE "LIVEYERES"

In Labrador, as elsewhere on the northern frontier, natural selection is producing a type of man well adapted to a changing environment. This new type will in time supplant the Indian.

In a country where elemental conditions prevail as they do in Labrador natural selection is not an academic term but a stern reality. Nature undertakes to make of every man who claims a home in Labrador either a hunter or a fisherman. For the failures starvation waits just round the corner. The man who is a product of an environment where these two arts are not important or essential must, when he comes to Labrador, speedily acquire them unless he is able to maintain his connections with his old environment and its resources. Failure to do so means elimination by starvation. The tragic death of Leonidas Hubbard illustrates the remorseless way in which

this fundamental law works in this region. The operation of this relentless law is likewise seen in the case of the Indian when, every few years, the caribou is scarce or the fishing poor. For the Indian persistently refuses to learn the lesson of making provision for the future although his ancestors have experienced the famine demonstration hundreds of times.

The hardy French and English fishermen who came into the region a century and a half ago found it to their liking as did the agents of the Hudson's Bay Company who followed them. They and their successors have left as descendants a brown-skinned race of Indian or Eskimo extraction on the maternal side. These are the "Liveyeres," as they are called to distinguish them from the Newfoundland fishermen who do not "live here" but come and go with each fishing season. Unlike the Indian (Figs. 9 and 11) who is willing to starve but not to work when game is scarce or the caribou fails, the Liveyere is apt to have the industrious habits of his paternal ancestry. Many of them have comfortable cabins always well stocked with rifles and supplied sometimes with a few books and in one instance which I recall with a small organ. Throughout the summer they devote themselves to the salmon and trout fishing in Lake Melville and in winter to trapping. These brown-skinned sons of the forest are apparently oblivious to the existence of the insect pests. A man new to the country frequently finds his eyes swollen almost to blindness for the first three or four days, but the swelling passes away after a few days, and the initiate is then, as regards swollen features, more or less immune for the remainder of the season. I can claim a fairly intimate acquaintance with mosquitoes of both the Yukon and Mackenzie valleys but am prepared to take off my hat to the quiet efficiency of the Labrador black fly.

It is reported that the failure of one of the sawmills was due in part to the refusal of a shipload of laborers imported from Europe to labor after their arrival in the land of the black fly. It does not require much imagination on the part of anyone having a speaking acquaintance with this little insect to guess why these foreigners developed an intense longing for their homeland shortly after their arrival in Labrador. If the management of this mill had relied more on the French Canadian timber cruiser and lumberjack and the Liveyere, there might have been a different sequel to record concerning the venture.

The black flies and mosquitoes, on which my cook exhausted a new set of adjectives every day, were treated merely with silent contempt by my native guide. He never deigned to use either head net, tar dope, or adjectives against the flies which the deep-sea cook declared to be immeasurably more disturbing to his peace and happiness than any of the shipwrecks which had fallen to his lot in happier days. The Labrador native is in many cases a fine type of man, patient beyond belief, not only with the black fly but with the 60 per cent import duty assessed by Newfoundland on all of his food and clothing not taken from the forest or the sea. At the approach of winter he goes into the forest for the trapping season, sometimes with a companion

e is a long one, four o'clock in the morning will find a good trail. These men appear to be as perfectly adjusted to and their environment as the foxes and the otters whose pelts

# A MAP OF THE DISTRIBUTION OF POPULATION IN SWEDEN: METHOD OF PREPARATION AND GENERAL RESULTS*

By Sten De Geer

University of Stockholm

Even today geography, in common with history and the biological sciences and ethnography, tends not infrequently to emphasize the unusual, the scientifically or popularly remarkable, at the expense of the usual—of that which is typical of nature, normal for cultural development, and of practical importance.

## Need of Quantitative Data

Explanation lies partially in the lack of *quantitative* data whereby investigators in their several fields would be in position to discriminate and to give due weight to principal as distinguished from subordinate phenomena. It is a condition that modern research aims to rectify, yet even among present-day scientists the importance of quantitative investigation is far from being recognized. This attitude arises in part from a still general inconclusiveness of treatment; the method of "averages" ought to be regarded with skepticism. What is needed in any field of investigation is a sufficiently full collection of figures susceptible of graphic representation in such a manner that not only averages but enlightening and interesting details may be brought out in their proper quantitative relationships.

Not least is this true of geography. So far it is only in isolated instances that geography has developed suitable methods of expressing graphically on maps such collections of facts as will permit the drawing of general conclusions. The old descriptive geography seldom based its pronouncements on a sure quantitative basis; nor indeed does the new genetic geography which extends its view backwards toward the causes and forwards toward the effects of the facts treated. It appears to be different, however, with the new descriptive geography; and we may hope, so far as source material permits, that it may develop into a genetic-quantitative geography, charting in a clear way its detailed results with regard to chronological as well as spacial relations.

The possibilities of quantitative representation of geographical data are illustrated by the cartographical method described below. It would seem to be applicable not only in the case of distribution of individual objects—

* Karta over befolkningens fördelning i Sverige den 1 januari 1917. Med statsbidrag utgiven av Sten De Geer. 1 : 500,000. 12 plates in atlas, 22½ x 16 inches. Stockholm, [1919] (see note in the *Geogr. Rev.*, Vol. 9, 1920, p. 360). The atlas is accompanied by an explanatory text of 296 pages from which the following article has been prepared.

human beings, dwelling houses, domestic animals—or mass quantities—kinds of land, timber content of forests, economic production—but even in matters of physical geography. The method which is applied to the study of population distribution in Sweden will now be described.

## Population Maps

On maps in general, population distribution is represented indirectly and usually very imperfectly by symbols showing the position and size of cities and towns and perhaps smaller centers. Maps showing relative density of population by shading or coloring give a graphic idea of population distribution as a whole provided that the strength of the tint is made directly proportional to the density of population, a desideratum seldom achieved. Furthermore, as a rule such maps show only the average over large areas, such maybe as county divisions or parishes. Details and the actual grouping of the population can be shown only by absolute methods. These methods, however, have been little used for the reason that they have employed different and often arbitrarily chosen symbols and thus are not readily intelligible.

There are four possibilities of symbolism: dots, lines, surface forms, and representation in the solid. In the mapping of relative density the first three methods have been put into use; but the fourth, the three-dimensional representation, has hitherto been neglected and has remained untried. It has been used by the author in his development of the dot method.

## Development of the Dot Method: Theory

The *dot method*, as now developed and applied to the map of population distribution in Sweden, offers the possibility of combining a clear representation of situation and mass of population within quite wide limits. The dot method, of which several variants have been worked out, originated in the author's researches on the settlement of Gottland which began in the year 1906 with an unpublished map of the density of habitations on the island calculated by squares of four square kilometers dimension. By this method of procedure the map picture took no cognizance of the run of the parish boundaries. Division of the parishes into small parts proved to be necessary in order that the most characteristic differences in density might appear. Although the contours were angular and lacking in fullness of detail, the map showed clearly the four most important desert zones and several other features of interest.

It would have been easy to make new trials with ever decreasing squares in order to smooth the boundary lines and achieve detail, but the idea was at once carried to its logical conclusion with evolution of the following principle. The *squares ought to be made infinitely small.* They then become mathematical points; and representation is freed from the fallaciousness inevitable in any average calculation. In other words *absolute* method is

substituted for *relative* method. According to this, habitations should be represented on the map as small dots, one for each house, properly located.

It proved impossible, however, to make such a map of Gottland with the help of existing maps, since even the topographic sheets of the Swedish General Staff map (scale 1 : 100,000) do not give the entire number of houses especially in the more densely populated places. On the other hand information as to the total number of persons in the various parishes is readily accessible in the publications of the Statistiska Centralbyrån, Stockholm. Hence it was decided to use the number of persons in the parish as the quantitative element, the location of dwellings on the map determining the geographical position of the quantity, i.e. its more detailed distribution within the parish. From such sources there was constructed in 1908 a dot map of the distribution of population in Gottland.[1]

## Distribution by Persons Versus Distribution by Habitations

As a factor contributing towards the geographical landscape, habitations are unquestionably more important than inhabitants; though, on the other hand, inhabitants mean more economically and are significant as active agents, changing the aspect of the landscape including the habitations. But both habitations and inhabitants are closely related genetically and practically; so that, considered in the large, the two factors tend to show the same distributory relation.

As has been said above, the simplest and most correct principle for construction of a house map or a population map is one dot for one object—for one house or one person. People, however, are mobile, and in the most refined analysis this should be taken into consideration; that is the number of persons for a given place should be multiplied by the percentage of time they spend in that place. The relation expressed might have reference to seasonal change—person-months; thus might be depicted the reindeer-keeping nomads, peoples practicing transhumance, summer migration of the city population, movement of fisher folk. Or the relation might be person-hours, having reference to daily movement, as in the case of large cities where the population flows in and out to and from the central working district. Inclusion of the time element, however, is limited by lack of statistical data.

## Choice and Size of Dot Units

If the scale of the map is small it may be desirable or indeed necessary to let every dot indicate two or more objects. The essence of the method, however, is that *all the dots are of the same size and value*, that is to say they constitute units of a fixed quantitative value. In the map of Gottland (1908) on the scale 1 : 300,000 each dot represented 10 persons, a relation that may be most briefly expressed by saying that the *ten dot* is used. In

[1] *Ymer*, 1908, p. 240 and chart 4 facing p. 252.

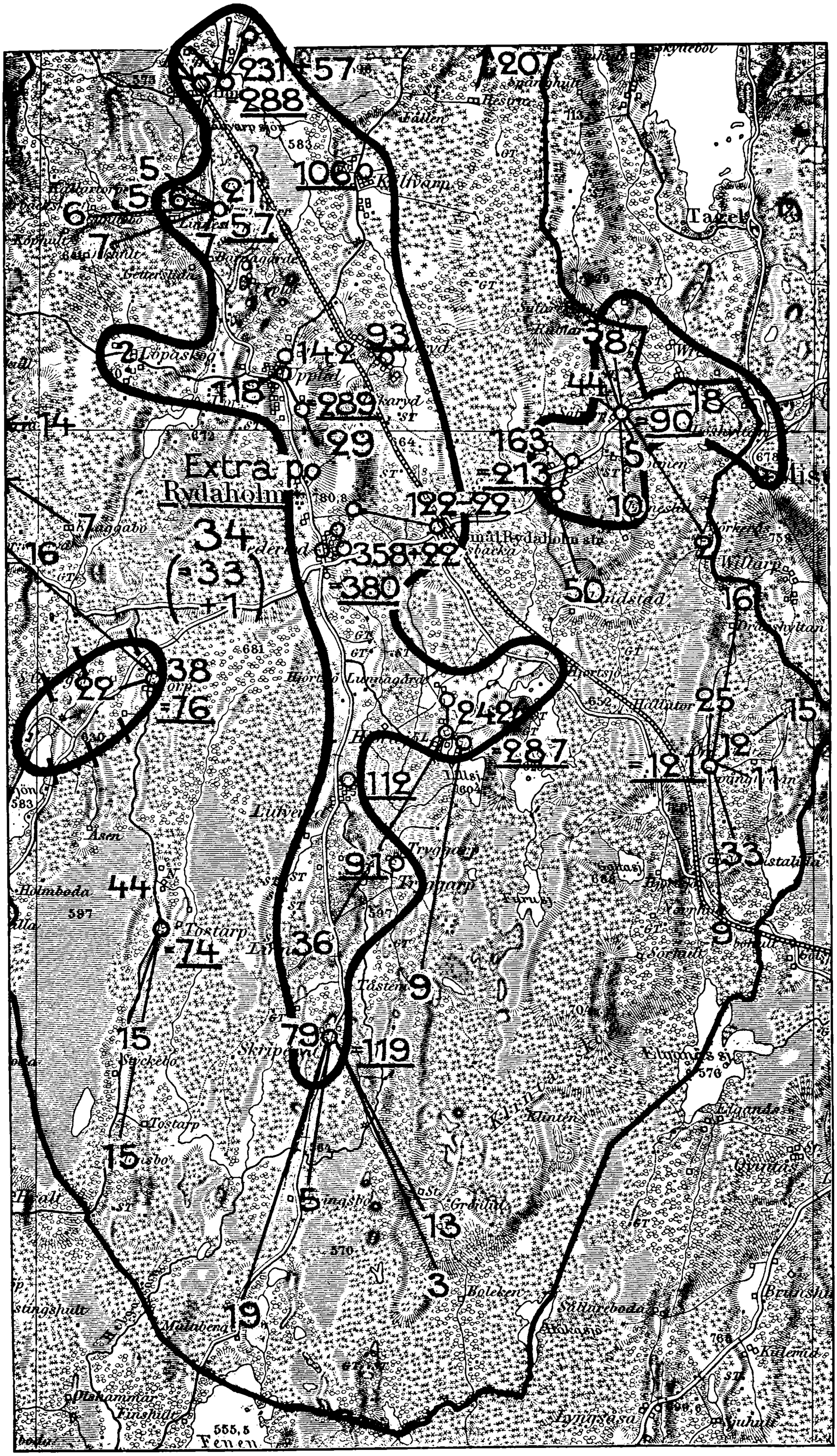


FIG. 1—Rydsholm parish in Småland, southern Sweden, showing how the inhabitants are localized on a map on the scale of 1 : 100,000 and how the numbers are added up to hundreds for representation by dots. The most extensively cultivated parts of the parish are inclosed with a heavy black line.

1914 the author published a map of the world [2] on the mean scale 1 : 80,000,000 with unit dot for 1,000,000 inhabitants; whence it may be seen that dot charts are in no wise restricted to large scales or low dot values.

In addition to the question of scale the choice of dot value depends on the nature of the distribution and its density within the area in question and on the purposes for which the map is destined. The dots should be larger on wall maps and smaller in proportion as the map is to be viewed at closer range and in harmony with other features of the drawing, thickness of lines, and amount of detail.

The individual dot on the dot map should preferably be drawn on the ratio between the natural size of the object and the fraction of the map scale. On the smaller map scales, however, one must be satisfied with having the dots enlarged symbols of the object represented. For comparison between different maps it would be an advantage if the amount of this enlargement could be fixed, either in terms of the actual size of the object in relation to the map scale or to a uniform measure expressed in millimeters or square millimeters. In 1908 the latter method was suggested by the author as it would more easily lead to uniformity. Thus the red unit dots for Gottland were given a diameter of exactly 1 millimeter, corresponding to a surface of 0.79 square millimeter, instead of a surface of 1 square millimeter and a diameter of 1.13 millimeters. The only large city here is Visby, and this was represented by a rectangular symbol measured in even millimeters.

## Use of Three-Dimensional Symbols: The Sphere

The problem with reference to the population map of the whole of Sweden proved, however, to be very different since the cities here were to be drawn as large spheres side by side with the unit dots. It was found best then to calculate on a basis of unit volume, the unit dots representing the unit of volume. The most suitable unit proved to be the cubic millimeter with radius of 0.57 millimeter and dot diameter of 1.15 millimeters.

The unit dots are considered as small spheres and ought to be shaded as such to produce the right volume impression, i.e. mass effect, in relation to the variously sized spheres representing the larger cities. Practically, however, this is difficult of achievement. A possibility would be to use a circle filled in with solid color save for a round white dot in the northwest quadrant, but the expense involved in this case has made impracticable any such application of the three-dimensional method of illustration. The unit spheres have been colored solidly (black), and they must be pictured as globes by an effort of the imagination. This modification of symbolism, however, carries with it one advantage, namely, that the unit dots stand out more prominently, in fact as prominently as possible in respect of their size. Viewed from a distance this is a particular advantage, and it is indeed

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[2] Sten De Geer: Oceanernas trafiklinjer, Medd. från Handelskammaren i Karlstad, 1914.

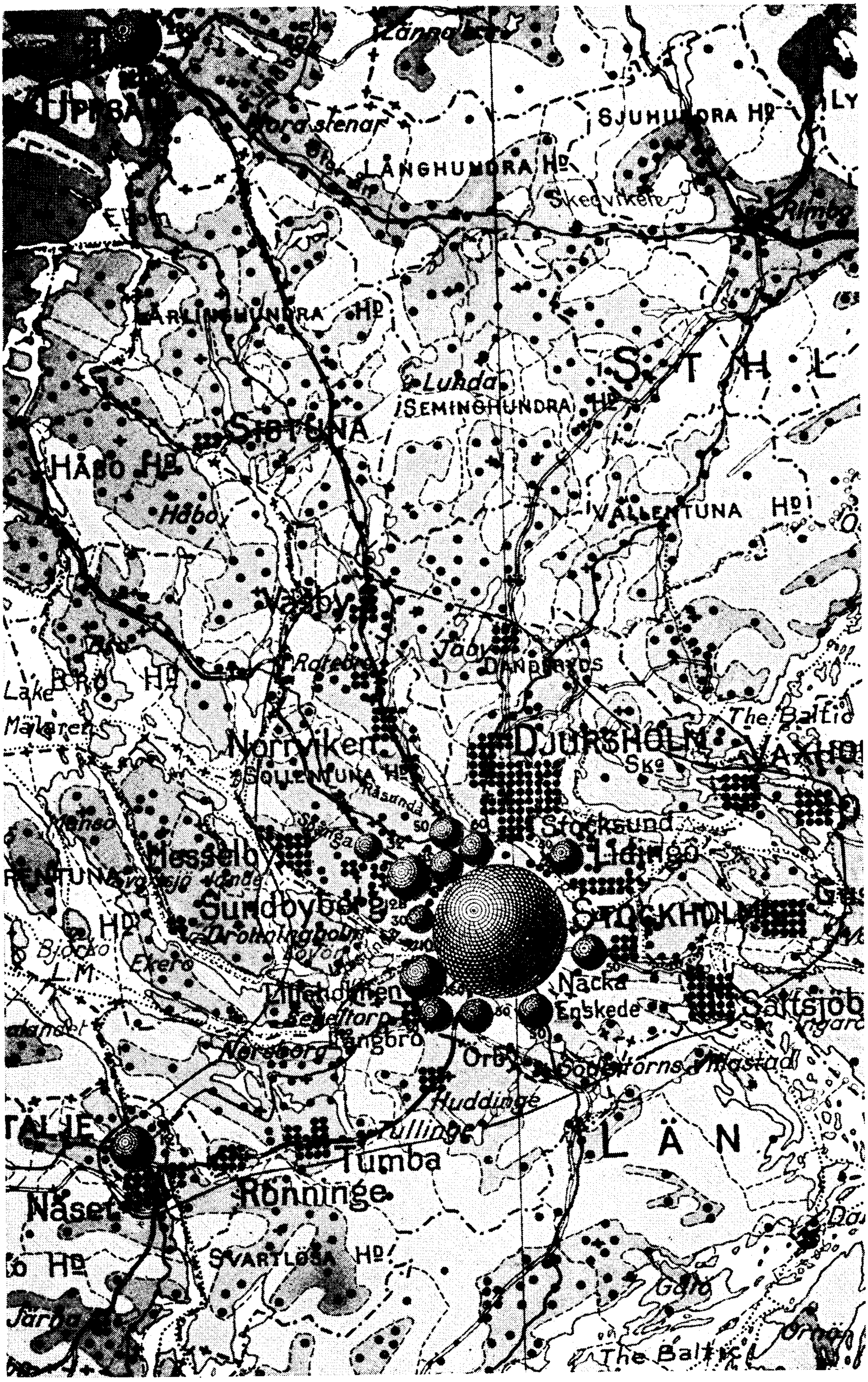


FIG. 2—Stockholm and district from the population map of Sweden, scale 1 : 500,000. Each dot represents 100 persons. The figures by the spheres indicate the number of dots comprised therein. On the original map cultivated areas are shown in yellow (here the darker shade of grey); communications, administrative boundaries; and names in red (here black); water in blue. A thin black line defines the area of

a question whether the practical gain as a whole does not to a considerable extent overbalance the theoretical loss.

It is an indispensable requirement that any population map, as any other cartographical expression of mass or density, should be clear and unequivocal, that is that there should be strictly proportional grading of symbols in respect of magnitude or strength of color or the product of magnitude and color strength.

For the population map of Sweden an absolute method was used in which mass was represented not by color strength but only by size. The dot method used for the map of Gottland was developed to include the larger cities by spheres and spherical shading. Under this plan the greater part of the population has been depicted by means of 100-unit spheres which, however, for technical reasons already mentioned have not been shaded, the shading being confined to the spheres representing the larger cities. The 100-unit dots indicate villages, fishing places, industrial centers, and trade centers and cities proper of not more than 5,000 inhabitants. Unit dots in fact have been used wherever space permitted on account of their greater degree of clearness and of the ease with which the number of inhabitants could be determined by counting the dots, which latter is an easier operation than the computation necessary in the case of the spheres.

## Arrangement of Dots

By this means larger and smaller groups, sometimes with as many as 50 dots, have come to indicate a certain densely populated place, or a townlike community, while other groups of dots indicate villages or other agricultural settlements. For this reason the author has further elaborated his method evolved in 1908 by the arrangement of dots into squares, rectangles, or other figures closely corresponding with the actual surficial extent of the settlement. By regularly arranged rows of dots the densely populated places of urban character are distinguished from the irregularly massed dots of the rural communities. Undoubtedly inconsistencies and perhaps even mistakes occur in the working out of this distinction, but it is admittedly a gain to the interpretative quality of the map.

## The Dot Net

A row of regularly arranged dots comprises dots of 1.15 millimeters diameter separated by spaces of 0.1 millimeter; thus four dots in a row occupy a space of 4.90 millimeters, or practically 5 millimeters, and this has served as a standard and control in the drawing of what may be termed the *dot net*. On the population map of Sweden the regular groups of dots are built up along east-and-west or north-and-south lines, a contrast in this respect with the Gottland map whereon they were orientated according to the longitudinal axis of the community. The orientated dot nets make the difference between agricultural and industrial population stand out clearly.

### Limits of Use of Dot Net

Construction of the population map includes among its tenets that "a dot shall fall entirely within its own parish." But it is evident that the dot net which calls for an unduly large area may fall partially over bordering parishes. When this disadvantage becomes too great, that is in general about the limit of 5,000 inhabitants, the larger spheres are used instead. Thus the Stockholm sphere has a radius of 8.9 millimeters corresponding to 371,000 inhabitants, while a circle of the area of the unit dots would have a radius of 34.4 millimeters, and similarly a dot net of 3,710 dots would cover a square of 75 millimeters side. As has been pointed out, the quantitative value of the spheres is not so readily estimated; hence, to facilitate comparison, the value of the sphere expressed in units is indicated by figures placed within or by the side of the sphere; thus by the sphere for Stockholm is the figure 3,710.

As was said above, the upper limit for the use of the dot net is round about 5,000 inhabitants. Some regional trade centers with a somewhat smaller population have, however, been given the sphere symbol; while, on the other hand, a few mining and industrial centers with a larger number of inhabitants have been shown by dot nets for the sake of consistency. The lower limit for use of the dot net may be thought of as about 1,000 inhabitants, a figure the author arrived at some years ago as a reasonable lower limit of urban settlement in the Scandinavian countries. Work on the dot map, however, has shown that this limit cannot be maintained in the representation of population density. To be sure, the urban character of places disappears at about this value or perhaps even above it; but a smaller agglomeration may yet be sufficiently densely populated and, unlike the agricultural village, may function without direct dependence on the immediate surroundings so that it is desirable to distinguish it from the ordinary rural community. The lower limit of the dot net must therefore be set at a lower figure—four dots, sometimes even two dots or a single dot, may be regarded as representing characteristics pertaining to the dot net. Dot nets of three or four dots, i.e. 300 to 400 inhabitants, may be clearly distinguished on the map from agrarian population groups, and furthermore they are usually identified by name.

## The Dot Method in Practice

While the theory of construction of the dot map is simple, the actual working out is relatively complicated. Surprisingly little can be done mechanically even when one is equipped with adequate data of numerical and spacial relations.

### Processes of Construction

Whether the basis of distribution is made from the number of dwellings counted on the map or the number of inhabitants according to census

statistics, the work involves two processes. First comes a trial gathering of the smaller settlements into groups of 100 inhabitants or the number of farms corresponding to that amount; while, on the other hand, the larger settlements, towns and cities, are divided up into parts corresponding with the number of dot units (total numerical values being rounded off to even hundreds). The second process is the careful determination of the position of the dots on the map, whether dot nets or single dots.

In the case of the dot nets the choice lies between a possible square arrangement or a form accordant with the areal extent of the place or the available space on the map.

## Rules for Placing Dots

Three rules have been drawn up for guidance in the placing of single dots representing groups of isolated houses or small hamlets. First, the dot should be set directly over that place which has more than 50 inhabitants, i.e. more than half the total number represented. Secondly, it should be placed near the center of gravity for the group as such. Thirdly, its position should be determined with due regard to circumstances of density and position of the neighboring groups and indeed to the distribution in the parish as a whole. Near parish boundaries consideration must also be given to dots of the bordering parishes. Thus, for instance, two adjacent border villages of 50 inhabitants should not be represented by two dots but by a single dot. If a dominating settlement is lacking, then the position of the largest existing habitation is to be taken as the position for the dot; but the smaller it is, the more regard must be paid to centralizing the position in relation to the other habitations of the group. As may easily be seen, the three rules are at constant variance with one another; in compromising between them geographical judgment must be brought to bear upon the problem, and hence no fixed rules can be laid down.

In choosing positions for the dots the novice strives more or less unconsciously for an even spacing in an effort to balance mistakes in grouping. But when one becomes accustomed to the work or is in possession of a fuller collection of facts or has a greater knowledge of the character of the region in question, one is particularly on the lookout to depict the actually existing contrasts, aggregations of dots as well as wide empty spaces. Only exceptionally and after long familiarity can the most telling picture of the distribution of population in a large parish be secured without rearrangement and often complete redistribution for the entire parish.

Experience has shown that geographical judgment and care have in fact greater influence upon the correctness of the dot picture than differences between the methods of procedure in the proportioning of the dots.

## Habitation Density in Relation to Character of Settlement

The distribution of population which has been represented by means of dots and large spheres constitutes the most important geographical feature

of the map, the further content of which has been selected with regard to its causal connection with the population factor. Most closely connected with population distribution is the distribution of improved land, the two factors making reciprocal demands upon each other.

Areas of dense habitation in general represent the cultivated and settled country. Experience with the population map has shown that the settled country can largely be defined by generalization of the facts presented by the dots. This has been confirmed as a result of two different and for the most part independent investigations, one of the population and the other of the extension of improved land.

## Map of Relative Population Density

The problem of representing the various degrees of habitation density may seem identical with the task of constructing a map of relative population density (free from the limitations imposed by administrative and other artificial boundaries) on the basis of the absolute dot map. Heretofore, for lack of formulated method in treating a sufficiently large collection of data in a manner at once thorough and detailed, the selection of grades of population density has either been arbitrary or has been based on too generalized criteria, with consequent sacrifice of actually existing and typical variations to averages and thus to the detriment of the geographical quality of the map.

There are two kinds of objective method for the determination of relative density on an absolute dot map. Curves showing dot density may be interpolated mathematically between the dots, or else by taking into consideration geographical, natural, or cultural boundaries one may endeavor to draw rational limits of dot density. Both methods have been tested, and both in fact have been used on the population map.

Heretofore it has been the practice to distinguish a large number of grades of population density. Through detailed study of the actual grouping of population this has been proved untenable. In respect of the population density of Sweden, at most five grades of density can be recognized: uninhabited country; scattered settlement, thin settlement, dense settlement, urban settlement. In general, however, the scattered and thin settlement may be thought of as consisting entirely of small densely settled spots scattered over wide stretches of uninhabited land. The three essential degrees of density in this case would be: uninhabited land, dense settlement, urban settlement.

On the population map of Sweden the area of connected dense settlement has been shown by deep yellow color: this together with the black dots outside of it should be regarded as *inhabited Sweden*. It constitutes a complex system of largely cultivated surface with a population density of from 50 to 100 inhabitants per square kilometer. As the forest tracts here are abstracted from the area under scattered and thin population, so the

ground under cultivation should be separated from the more densely populated areas of industrial settlement. With this, then, would disappear the difference between the apparently well delineated density grade of dense settlement and urban settlement. Inhabited Sweden would then be considered as composed of a very large number of small areas having a population density of about 1,000 people per square kilometer and having approximately the extent shown by the dots and larger spheres on the map. The entire concept of population density is to a high degree relative, being dependent upon the dimensions of the areas to which reference is made. By the refinement suggested above progress is made from thinking in relative measures ("20 inhabitants to the square kilometer") to absolute numbers ("a population density tract with 2,000 inhabitants").

It is directly apparent from the map that, as far as large tracts are concerned, agriculture in Sweden always creates greater average population density than country industry has hitherto been able to accomplish. Where under exceptional circumstances agriculture and industry have developed in the same region, as in the Malmö district, the greatest average density has arisen.

If abstraction is made of all towns and industrial centers, the density grade of rural areas even within densely settled districts does not greatly exceed between 50 and 100 people per square kilometer. Furthermore, this density is undergoing a steady decline that has been in progress since 1865; partly as a consequence of emigration, as in Vermland (north of Lake Venern) for example, and partly because of the revolutionizing of agriculture by means of modern labor-saving methods, as in Scania as a whole. Among the densely peopled regions such areas show a comparatively thin settlement.

The greatest population density among Swedish agricultural areas is in the valleys of northern Sweden, wherein upper Dalecarlia leads with a density of 200 people to the square kilometer. There the old villages remain. The valley people love their homesteads, and, though their numbers have increased and the cultivated area cannot be extended, they have preferred to stay and divide their farms. The yields per square kilometer are now the greatest in Sweden. Forestry and industry also help to counteract an otherwise imminent depopulation in these settlements.

Such is a single instance of the comparative work that may be done on the basis of the population map. It has a practical value in an infinite variety of applications: in questions of readjustment of boundaries of administrative divisions or of social organizations, of the establishment of public or private institutions, of lines of communication, of the stationing of officials, of the selling of goods, of educational propaganda, of organization of traffic in times of peace and mobilization in times of war—in short, in any matter where it is necessary to know the number and grouping of people.

The map of population distribution can and ought to be causal in the

sense of showing, as many-sidedly and clearly as possible, the connection between this distribution and the most important geographical factors which influence or have been influenced by the grouping of population, whether these be natural or the result of man's activity. Nature, as well as the life of the people, is very changeable, and the geographical factors are many. Hence a strict limitation to a few factors becomes necessary for the preservation of clearness and legibility in the map. These are the ends that have been striven for in the working out of the population map of Sweden; though such are the difficulties involved that they are far from having been attained.

# THE GEOGRAPHICAL CHARACTERISTICS OF WESTERN FRANCE

By René Musset
University of Rennes

In the harmonious assemblage of regions that constitute France the individuality of the separate units is clearly recognized in the common parlance. Most highly individualized without doubt is that known as the "West." The word is vague, but its connotation is precise. The country folk know well enough where the West begins. The plains round Évreux, Chartres, Châteaudun, Vendôme, Tours, Poitiers lie on its border, but they are not of the West. Lieuvin and the *pays* of Auge, Perche, eastern Anjou, and the Vendée are included within its limits. We shall later consider in detail the significance of this limit; what concerns us immediately is the extraordinarily clear-cut nature of the boundary, a fact the more astonishing in that it corresponds to no geological or morphological boundary but without apparent reason cuts across uniform terrains. Outside the boundary regional change is marked; within one finds a prevailing uniformity only modified on approach to the sea. This uniformity is attested by physical and human characteristics alike.

## The Morphological Characteristics of Western France

From the point of view of physical geography the West is a unit. It presents a slightly accidented surface without sizable plains or forms of strong relief. The greatest elevations scarcely exceed 400 meters (417 meters in Bas-Maine, 391 in Brittany, 285 in Vendée); the limited areas of level land are found for the most part in the valleys. The general aspect of the country is that of an undulating plateau.

### The Border of the West: The Clay-with-Flints Peneplain

Approaching the West from the Paris Basin by way of Évreux, Chartres, or Châteaudun, for example, one rises slowly and regularly to the surface of a great plateau, almost completely level and unbroken by large valleys. It is interrupted by a sharp rise whose steep slopes mark the highest altitudes. From 120 meters it rises southward to 309 meters in the "Monts d'Amain," then sinks to 200 meters and less. In the region of Le Mans the edge of the plateau has been greatly dissected and the height is no more than 120 to 80 meters.

The plateau surface does not correspond to the outcrop of a layer of hard

rock. It is not a structural plain but an erosion surface, an old peneplain. From edge to edge it bevels in succession the tilted layers of the Upper Cretaceous, Cenomanian, Turonian, Senonian. The surface is constituted by a residual layer, clay-with-flints derived from superficial weathering of the chalk. The peneplain can be dated by the occurrence on its surface of unconformable fragments of an Eocene covering, the most ancient beds of which are Sparnacian; the clay-with-flints peneplain dates then from the end of the Cretaceous or the beginning of the Tertiary. The present inclination of this ancient peneplain is relatively great; the original slope was evidently much gentler. Examination of the present altitudes shows that it has suffered deformation by uplift which affected in particular those parts now most elevated. This uplift originally extended to the western limit of the plateau; the break of slope which bounds it corresponds to a sunken zone scarp more or less worn back in places by the ordinary processes of erosion.

## The Armorican Peneplain

Let us now turn farther westward, to Bas-Maine. This is a region of primary rocks, greatly folded and showing granitic intrusions. The folds have been worn down to their base; prolonged erosion has reduced the region to a peneplain. It now presents the form of slightly accidented plateaus, clearly distinguishable on the topographic map and easily visualized as parts of a continuous plain. Here and there upon the surface appear Eocene sediments resting discordantly upon the worn primary terrain. This peneplain, as I have shown elsewhere in detail,[1] is the result of an almost complete base-leveling. It dates from the end of the Cretaceous or the beginning of the Tertiary.

It is similarly developed over the other ancient terrains of the Armorican massif—in the Norman Bocage and in Cotentin to the north, in Anjou to the south, and westward in Brittany, where M. de Martonne has proved its existence.[2] The entire area exhibits levels of the same aspect and of the same age formed under the same conditions. Over the surface throughout are scattered numerous fragments of Eocene deposits, notably in Brittany.[3]

The peneplain of Bas-Maine is only a portion of a great peneplain involving all the Armorican massif and hence known as the Armorican peneplain. On the periphery of the massif it can be traced beyond the outcrops of ancient rocks on the secondary rocks of the border, truncating their layers obliquely and in places carrying on its surface Eocene deposits. Where chalk existed whether of Cretaceous age, as in the case of the clay-with-flints peneplain, or of Jurassic age, its surface is composed of clay-with-flints.

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[1] René Musset: Le Bas-Maine, Paris, 1917.

[2] Emmanuel de Martonne: La pénéplaine et les côtes bretonnes, *Ann. de Géogr.*, Vol. 15, 1906, pp. 213–236 and 299–328.

[3] The Eocene fragments in Brittany are generally omitted from the geological map, scale 1 : 80,000.

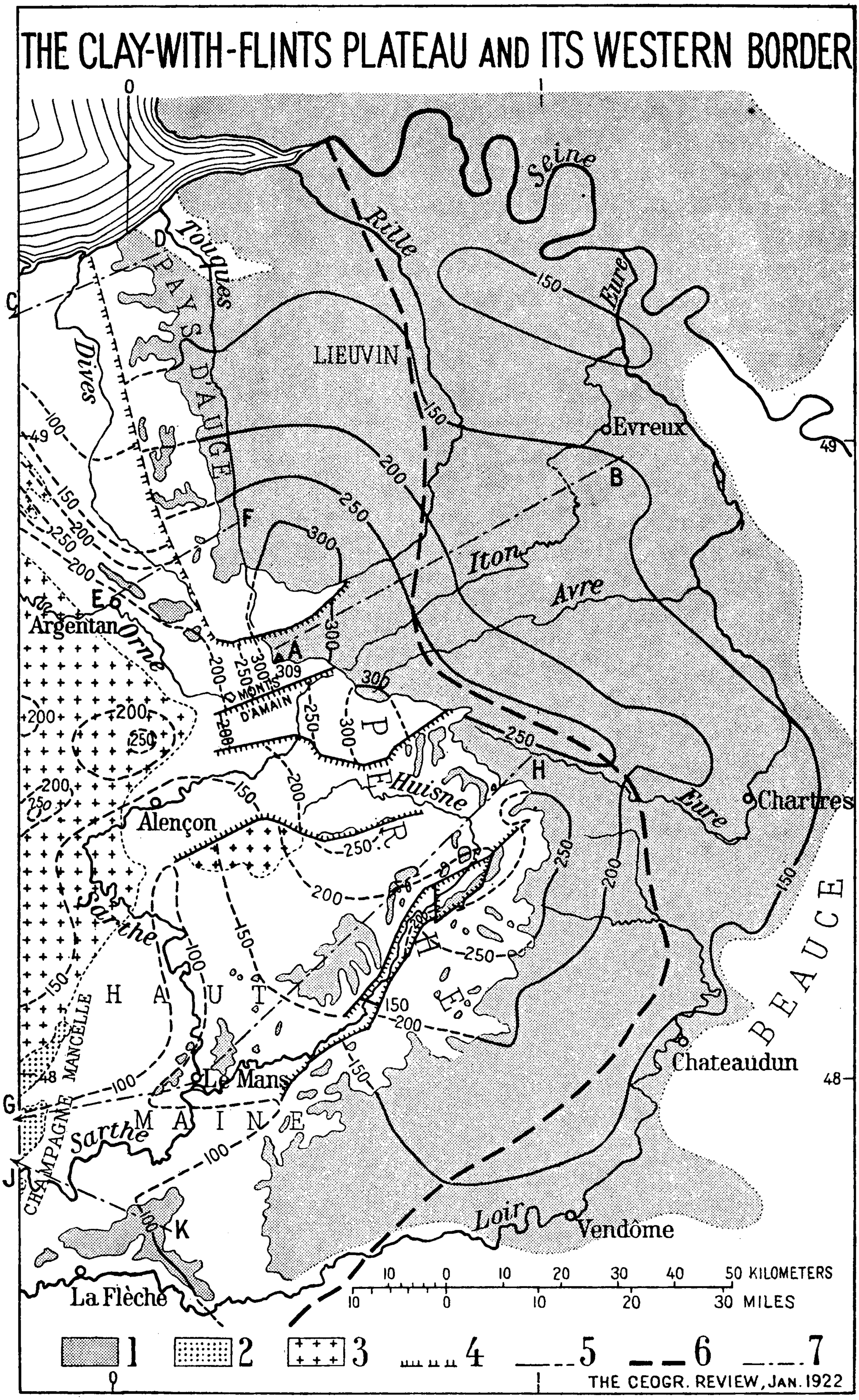


FIG. 1—The clay-with-flints plateau and its western border. Reference to numbers in key: 1, clay-with-flints on Cretaceous rocks; 2, clay-with-flints on Jurassic rocks; 3, ancient terrain of the Armorican massif; 4, faults (cross lines indicate direction of downthrow); 5, lines of sections shown in Figure 2; 6, western limit of *bocage* and the "West"; 7, contours of the peneplain of Western France (figures give altitude in meters). Scale approximately 1 : 1,300,000.

## Relation Between the Clay-with-Flints and the Armorican Peneplains

The clay-with-flints and the Armorican peneplains are contemporaneous. On the surface of both appears clay-with-flints, especially on the former.

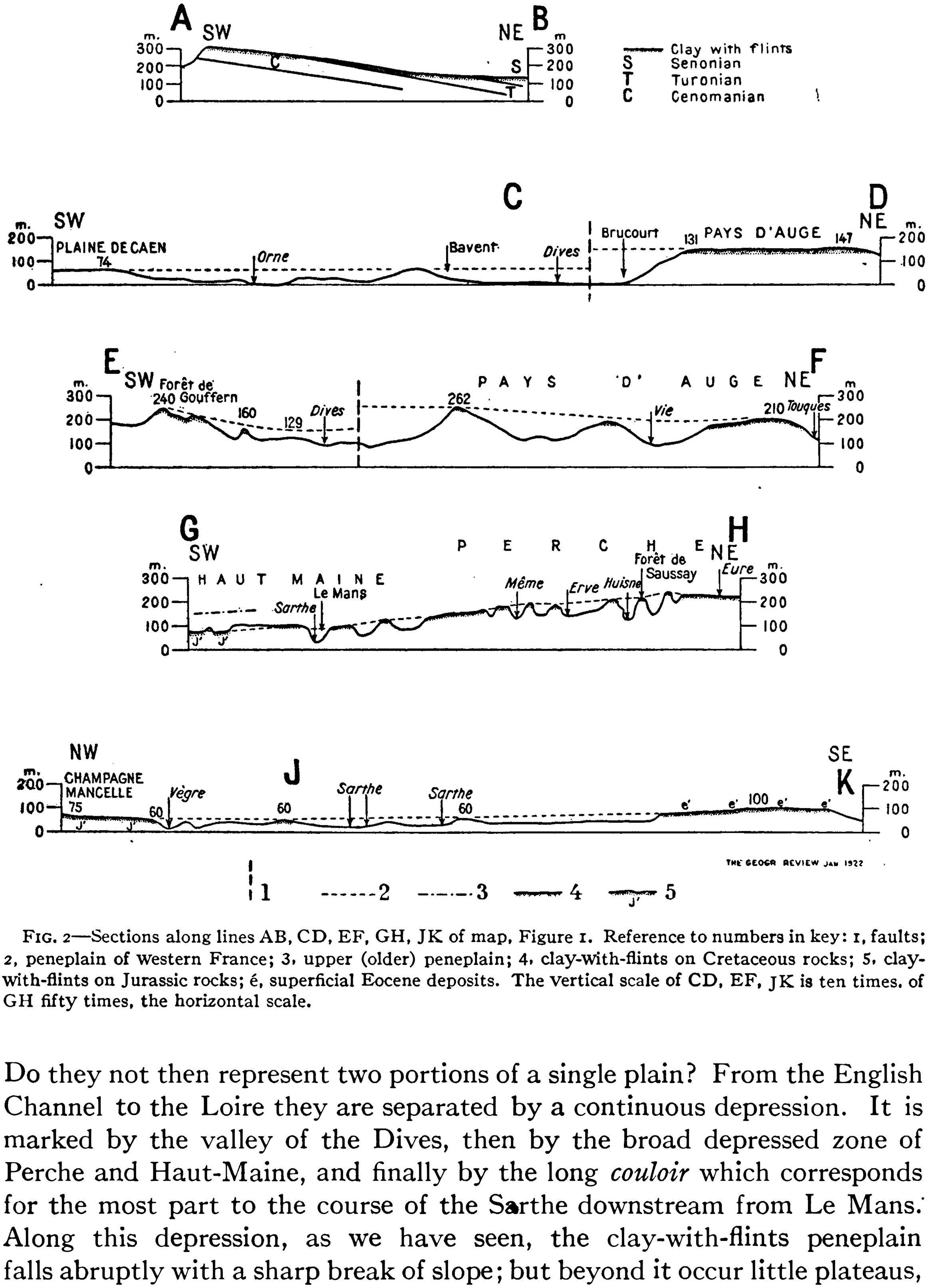


FIG. 2—Sections along lines AB, CD, EF, GH, JK of map, Figure 1. Reference to numbers in key: 1, faults; 2, peneplain of Western France; 3, upper (older) peneplain; 4, clay-with-flints on Cretaceous rocks; 5, clay-with-flints on Jurassic rocks; é, superficial Eocene deposits. The vertical scale of CD, EF, JK is ten times. of GH fifty times, the horizontal scale.

Do they not then represent two portions of a single plain? From the English Channel to the Loire they are separated by a continuous depression. It is marked by the valley of the Dives, then by the broad depressed zone of Perche and Haut-Maine, and finally by the long *couloir* which corresponds for the most part to the course of the Sarthe downstream from Le Mans. Along this depression, as we have seen, the clay-with-flints peneplain falls abruptly with a sharp break of slope; but beyond it occur little plateaus,

or hill summits, capped by clay-with-flints, evidently remains of a prolongation of the clay-with-flints peneplain, although at a lower altitude. At the same time they effect a junction with the Armorican peneplain.

The regions of Perche and Maine furnish the best illustration (map, Fig. 1, and sections, Fig. 2). The uplift which affected the region and which is still distinguishable in the part of the clay-with-flints plateau that has been preserved had for its result here in consequence of its intensification a foundering of the entire key of the arch. The Perche appears as a depressed area, cut by numerous faults, trending roughly east-west or southwest-northeast, variable in downthrow and magnitude. Between the faults are plateaus and hills crowned by clay-with-flints and Eocene fragments similar to those of the clay-with-flints peneplain but lower in altitude; they are in fact *buttes-témoins* standing at a lower altitude because they have participated in the general depression of the region. Along a section from the Upper Eure to Le Mans parallel to the Huisne the clay-with-flints peneplain has an altitude of 220 meters on the Eure, on its border it rises to 240 meters, then it only appears as *buttes-témoins* at altitudes of 220, 200, 180–160, 140, and finally 120–110 meters above Le Mans. Beyond Le Mans to the west of the Sarthe clay-with-flints of Cretaceous source are seen at 100 meters elevation. This surface is prolonged westward by clay-with-flint deposits of Jurassic source and of the same altitude in the Champagne mancelle. Now the Champagne mancelle in its turn passes without any break of continuity in Bas-Maine into the Armorican peneplain, which northeast of Laval has an elevation of 120–160 meters. The Champagne mancelle here corresponds to the lowest part of the depression. Analogous facts are observed farther north at the foot of the *côte* of the *pays* of Auge and again in the region between Le Mans and La Flèche.

It appears then that the clay-with-flints and Armorican peneplains are in fact portions of a single peneplain which we may call the peneplain of Western France, but they are separated by a zone of subsidence. This zone divides the West into two distinct parts. To the east is the clay-with-flints plateau adjoining the Paris Basin region; to the west is the Armorican massif with its marginal areas. The depression constitutes an important passageway providing a route for the chief north-to-south lines of traffic in the West. It is used by the roads and railways from Caen to Angers. At the points where these roads are crossed by east-west roads are situated a series of important towns, Caen, Alençon, Le Mans, Angers.

## Deformation of the Peneplain of Western France

The peneplain of western France, dating from the end of the Mesozoic or the beginning of the Tertiary, has been deformed by subsequent movements. The topographic map makes this clear. It shows the upwarping of the great clay-with-flints plateau by an epirogenic movement which attained its maximum effect where elevations are greatest, to the south of the *pays*

of Auge and to the northwest of Perche. The zone of concomitant subsidence now occupied by the valley of the Dives, Perche, and Haut-Maine and the valley of the Sarthe has already been pointed out. Two other depressions may be distinguished with equal ease. One is along the valley of the Loire upstream to Blois, the other across Upper Brittany from the mouth of the Loire and of the Vilaine to the English Channel about St. Malo. In both occur the calcareous shelly sands known as *faluns* deposited during invasion by the Miocene sea. Both depressions are followed by roads and railways, and the Vilaine depression also by the Ille-Rance canal. Large towns are naturally situated there—Angers and Nantes in the Loire valley, Rennes in the Breton depression. Finally there is another depression which was also invaded by the Miocene sea, the *col* of Cotentin, isolating the northern part of this peninsula from the Armorican massif (Fig. 4).

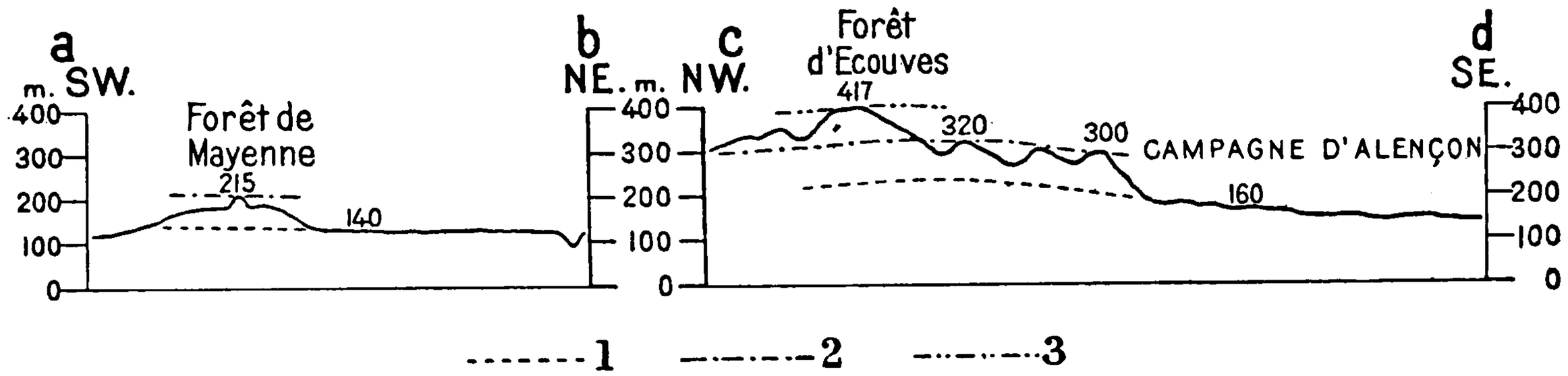


FIG. 3—Sections across Bas-Maine (ab) and the Campagne d'Alençon (cd). Reference to numbers in key: 1, peneplain of Western France; 2, 3, older peneplains. The vertical scale is ten times the horizontal scale.

Between these depressed areas the inverse movement has created the more elevated areas, the north of Cotentin, the Norman Bocage, Bas-Maine, Lower Brittany,[4] Vendée, the most isolated and least accessible parts of the West.

## IRREGULARITIES OF RELIEF ABOVE AND BELOW THE PENEPLAIN OF WESTERN FRANCE

In these elevated and isolated regions the peneplain of western France, though it constitutes the fundamental physical feature, does not occupy the entire surface. Above it in detached areas of more elevated relief are seen fragments of older peneplains; below are evidences of erosion at a lower level in a more recent cycle.

In Bas-Maine to the east of Mayenne rising above the major peneplain, which here has an altitude of 120–140 meters, is the narrow steep-sloped ridge of the Forêt de Mayenne, 200–215 meters in height. The level surface bevels old folded rocks. Similarly about the upper course of the Mayenne, where the major peneplain rises towards the south from 120 to 160 meters altitude, is seen another fragment of the older peneplain at an altitude of 240 meters.

[4] The terms Upper and Lower Brittany (Haute-Bretagne, Basse-Bretagne) have no reference to altitude: they originated in the relatively greater or lesser importance of the areas (the case of Haut-Maine and Bas-Maine is similar).

Above the level of this older peneplain rise narrow ridges, elongated, bounded on all sides by abrupt slopes with level summit surfaces often followed by trails. Such are the heights of the *forêts* of Multonne, Pail, Écouves, La Ferté, Andaine. They are the remains of a still more ancient peneplain now highly fragmented. These monadnocks owe their preservation to the resistant qualities of the constituent rock, Armorican sandstone

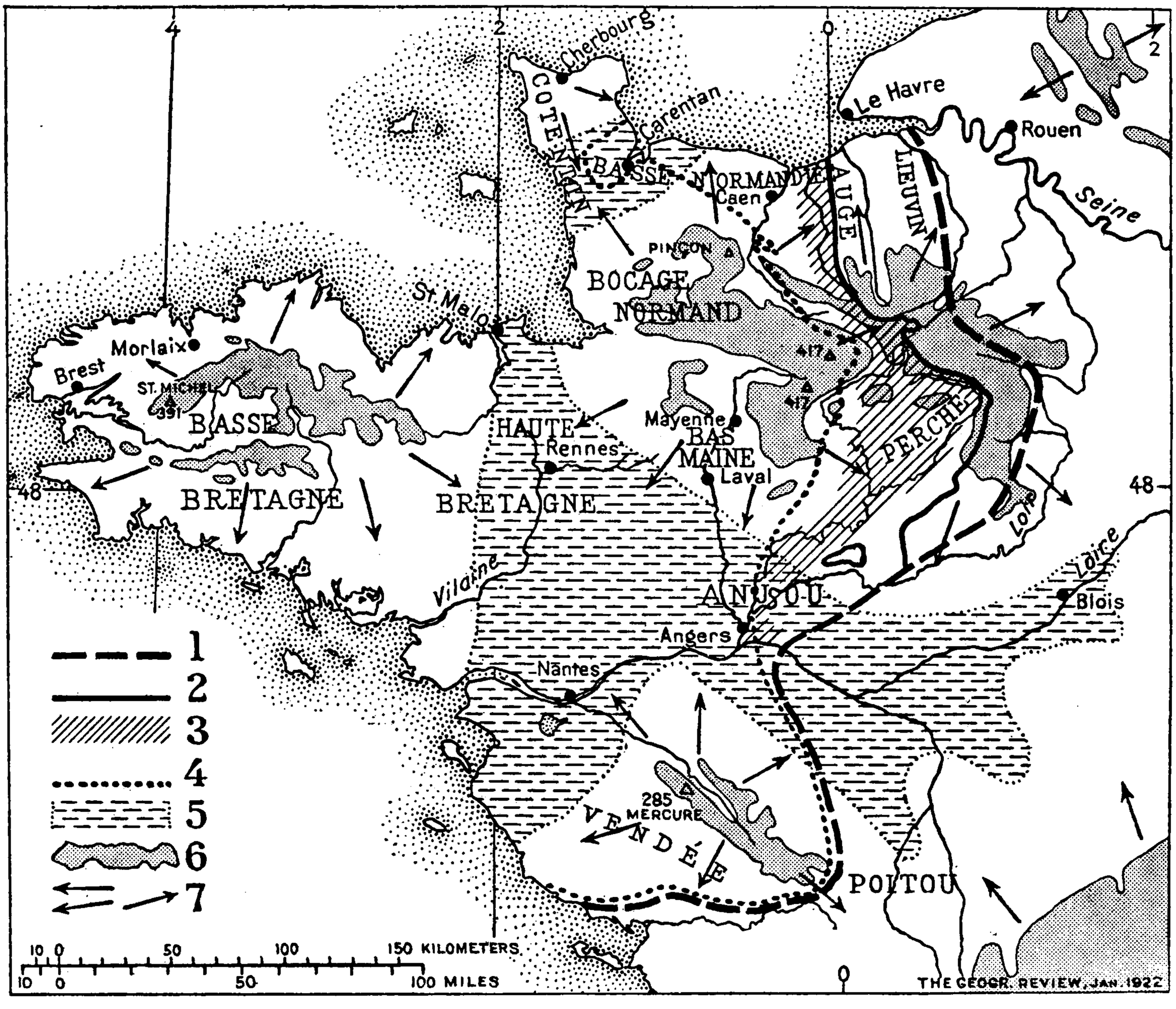


FIG. 4—Map of the West of France. Reference to numbers in key: 1, eastern limit of the *bocage* and the "West"; 2, western limit of the clay-with-flints plateau; 3, depressed zone at the foot of 2; 4, eastern limit of the ancient terrains of the Armorican massif; 5, area invaded by the *faluns* sea of Miocene times; 6, land above 200 meters altitude; 7, direction of slope of the peneplain surfaces. Scale approximately 1 : 4,400,000.

for the most part. They form the highest elevations of the West, 417 meters in the Forêt d'Écouves and the summit of the Avaloirs in the Forêt de Multonne.

Fragments of these two ancient peneplains may be distinguished in the Norman Bocage. The Mont Pinçon area offers a striking example. The major peneplain, which here rises from north to south from 100 to 200 meters, terminates abruptly against a steep slope leading to another level surface strung along the edge of which is a series of villages—Ondefontaine, Roucamp, Campandré, St. Martin; it is the lower of the two older peneplains. The higher peneplain is seen in Mont Pinçon, a flat-topped butte of

360–365 meters, an admirable observation post for the study of the facts here described. On the summit Cenomanian rocks appear, beveled by the surface of the peneplain, which is thus dated as posterior to this formation. Thus the three successive peneplanations which have left their traces in the relief of western France took place between the Cenomanian and the early Tertiary.

In Lower Brittany the three peneplains are developed about Montagne d'Arrée for example. The youngest peneplain has an altitude of 80 meters at Morlaix and rises towards the south to 140 meters where it is dominated by more elevated buttes, the fragmented remains of the older peneplain with an altitude rising from 220 to 280 meters about Plounéour-Menez.

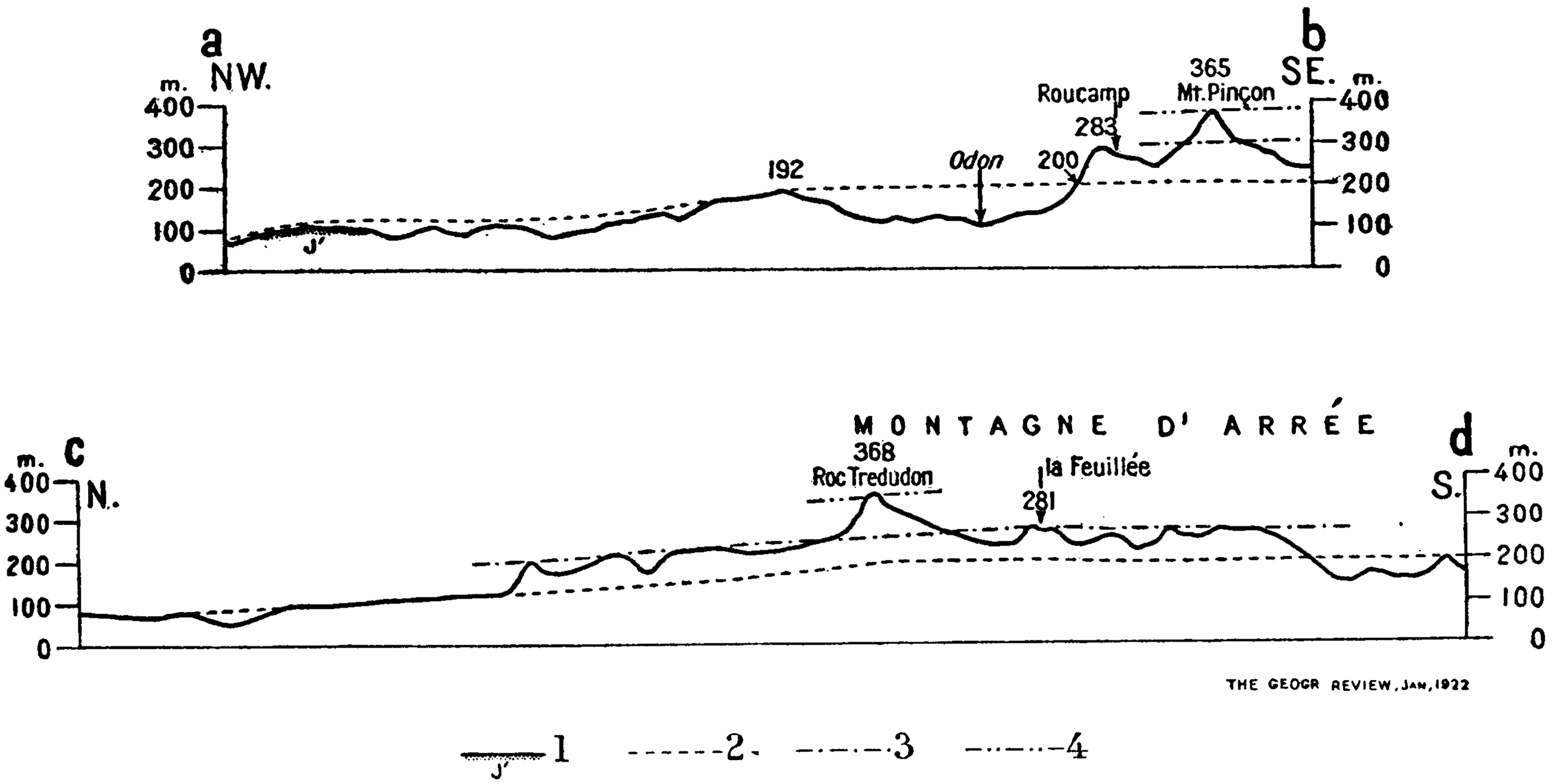


FIG. 5—Sections in the Norman Bocage (ab) and Lower Brittany (cd), the former passing through Mont Pinçon, the latter from a little south of Morlaix across the northern plateau and the Montagne d'Arrée. Reference to numbers in key: 1, clay-with-flints on Jurassic rocks; 2, peneplain of Western France; 3, 4 older peneplains. Vertical scale ten times horizontal scale.

Above, a narrow ridge whose dissected summits average about 360–370 meters (391 in the isolated butte of St. Michel-de-Brasparts, the highest point of Brittany) represents the oldest peneplain. Southward the younger of the two upper peneplains has an altitude of 280 meters about La Feuillée and the marshes of St. Michel, a region of topographic senility and poorly organized drainage; whence a rapid descent leads to the youngest peneplain.

In the Vendée two peneplains can be recognized, and in some isolated summits such as Mont Mercure (285 meters) the fragmented remains of the third. In northern Cotentin, however, are only two peneplains. From the *col* of Cotentin the youngest peneplain rises from 50 to 100 meters, where it terminates in steep cliffs along the shore. Above are the heights of La Hague, 170–180 meters.

Below the level of the peneplain of western France are the young valleys and plains developed in the course of a recent cycle (or cycles) of erosion,

due to changes in relative level between land and sea. The contrast between the different parts of the West is very clear in this respect. To the east on the great clay-with-flints plateau (an impervious layer resting upon pervious chalk) valleys are not numerous, and only the principal rivers are entrenched. Some of the streams, the Avre and Iton for instance, have a tendency to lose their waters by infiltration in the underlying porous limestones; and the work of subaerial erosion is thus retarded. The peneplain, almost entirely cleaned of later Tertiary deposits, is preserved in a state of great perfection. On the impermeable surface of the Armorican massif, on the contrary, the rejuvenated streams have begun dissection of the peneplain, transforming it to a surface irregular in detail. Entrenched valleys are numerous; such are, in Bas-Maine, the Sarthe between St. Ceneri and Beaumont and the Mayenne below the confluence of the Varenne; and, in Brittany, the Vilaine below Rennes and the lower parts of all the coast streams. In every section of their course the valleys show characteristics of youth. In Lower Brittany popular speech distinguishes between the *traon*, narrow, steep-sided valleys originating in the present cycle of erosion, and the *toul*, marshy valleys of ill-organized drainage in the upper courses not yet attacked by the revived forces of erosion. In the intermediate depression, between the clay-with-flint plateau and the Armorican massif, tectonic subsidence has facilitated the work of erosion; and large valleys such as those of Dives, Huisne, and the lower Sarthe have developed. Where subsidence has been greatest, and the rocks are little resistant, enlargement of the valleys has proceeded until they are expanded into genuine plains, such as that of the Dives or the "Vallée d'Auge" or of the middle Sarthe or the *pays manceau*, this latter on friable Cenomanian sands. On the areas invaded by the Miocene sea there are also large valleys or little plains, such as the "Gulf" of Carentan in Cotentin, the valley of the Loire, and the depression known as the "Basin of Rennes."

A final episode in the morphology of the region is a series of very recent movements of coastal subsidence as result of which the erosive activity of the rivers has been diminished and the lower ends of the valleys have been invaded by the sea. Thus have been formed the Breton rias and that extreme indentation of coast line that has contributed so greatly to the encouragement of maritime pursuits and the multiplication of ports along the Breton coast. All the valleys of the western rivers have a submarine prolongation, not only those of Brittany but also, for example, those of the Loire, Vilaine, and Orne.

## Human Geography of Western France

Study of the human geography of the region strengthens the impression of uniformity created by study of the morphology. It is, indeed, largely dependent on two physical facts which carry a train of consequences for human life: the impermeable soil and the humid, oceanic climate.

## Impermeability of the Soil

The West shows great variety in the age and composition of its constituent rocks, crystalline and primary in the Armorican massif, secondary (Jurassic and Cretaceous) in the eastern section. The older rocks are impermeable save over limited areas of limestone and sandstone, become semi-permeable through fissuring. The younger rocks are also impermeable; clays predominate; limestones are marly or superficially covered with clay-with-flints; sands are rare. There are, however, more extensive areas of bare limestone which form little regions distinctly drier and locally known as *plaines*. Thus, though the West is varied as regards the nature and age of its rocks, it is uniform in respect of that important physical quality, their impermeability. From this springs one of the most striking features in the physiognomy of the country—its humidness, or freshness; for in addition to impermeable soil there is a rainy climate.

## The Humid, Oceanic Climate

The West is strongly exposed to maritime influence by its position, well advanced into open ocean; its terminal, Brittany, is a peninsula surrounded on three sides by the sea. The dominant westerly and southwesterly winds, charged with moisture, bring abundant precipitation to the land. This fact need not be enlarged on here. A highly detailed study of the rainfall of western France has been made by M. Angot.[5] A few figures will suffice as illustration. The total annual precipitation everywhere exceeds 600–700 millimeters. Heavier rains fall on the peninsulas directly exposed to the winds. The western extremity of Brittany has 800–900 millimeters, the north of Cotentin over 800. The more elevated parts receive still heavier rains: the heights of Lower Brittany, of the Norman Bocage, and of Bas-Maine have over one meter; the rainiest stations are La Feuillée in the Montagne d'Arrée (1,181 millimeters), Edern in the Montagnes Noire (1,173 millimeters), Beauficel in the Norman Bocage (1,133 millimeters). The rains are evenly distributed throughout the year. Even in summer, when the least rainfall is registered, and at considerable distances from the sea the amount is considerable. Thus Laval, at an altitude of 60 meters, has the following monthly rainfall (average for 1851–1900):

| Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61 | 49 | 50 | 46 | 54 | 62 | 55 | 51 | 53 | 67 | 66 | 68 | 682 mm. |

For the region as a whole the ratio between the rainfall of the rainiest and driest months is about 3 to 2, and even in the western part it scarcely surpasses 2 to 1, low values. The essential fact, however, is not so much the rainfall as the humidity. Violent showers are rare. Precipitation is generally in the form of slow and gentle rains, which leave but little trace in the rain

[5] Alfred Angot: Études sur le climat de la France: Régime des pluies, Part I, *Ann. Bureau Central Météorol.*, 1911, Vol. 1, Paris, 1916, pp. 109–236. Résumé in *Ann. de Géogr.*, Vol. 26, 1917, pp. 255–272.

gage though they saturate the air, or in the form of fogs, of which the *crachin* of Brest is typical. Under the humid atmosphere the contours of the landscape are softened, and the penetrating moisture gives a pervasive air of freshness. This is so even in the least humid part, the southeast. At La Flèche, for example, where the exceptionally low rainfall of 541 millimeters would lead one to expect a drier country, the frequent drizzles are such that visiting strangers complain of the excessive humidity.

## Human Adaptation to Natural Conditions

There are in France other regions of impermeable rock; and, while the influence of the oceanic climate diminishes eastward, it is still apparent far beyond our region. But here in the west the influence of these conditions appears the more pronounced because of the human adaptations that have been made to them. Three of these adaptations are particularly striking: the grouping of population, communications, and the separation of the cultivated fields.

## Population Grouping

Dispersed dwellings accommodate an important part of the population. Not that all are isolated, however: the common type of settlement is intermediate between that of complete dispersion, nothing but isolated houses, as in Chalosse (southwestern Aquitaine), and perfect agglomeration with all the houses grouped round the church, as in Beauce. Every village of the western region includes two parts: the *bourg*, or little market center clustered round the church, and the *écarts*, or dispersed houses. These latter either are gathered into hamlets, like the *plou* of Lower Brittany, or into groups of two or three, or, as often, stand isolated. The origin of this arrangement is still obscure; but, whatever it may be, it is clearly well adapted to physical conditions. It is made possible (not determined) by the distribution of water which, furnished by the humid climate and retained by the impermeable soil, can be found everywhere near the surface. Exceptions appear only where the surface rock is permeable, for example in the *plaines* of Caen and Argentan and in a part of Alençon, where habitations are perforce grouped in a fashion different from the rest of the region. The countryman of the West prefers his isolated *borde* (little property) to the village. It is better adapted to his method of cultivation. What he wants is to be close to his fields to curtail as far as possible transportation and movement back and forth.

## Means of Communication

Difficulty of communication that weighs on all forms of activity is another consequence of physical conditions.

A century ago the main highways were few and ill-kept, and the country roads were almost impracticable. In the West they have a peculiar physiognomy. They are narrow and overtopped on either side with sloping banks over which trees, bushes, and briars form a tangle of vegetation. The roads

are as deep-sunk as trenches; when it rains, streams of water course along them; and at all times they hold thick mud. Carriages are mired therein; pedestrians prefer to travel through the fields where the pathways, or *chintres*, are better suited to their needs.

A journey by such roads is quite an undertaking. The physician Réaumur described travel in the Vendée in the early eighteenth century: "The axles of the little wheels of my coach," he wrote, "were constantly mired, and during the ten leagues of the journey it was continually necessary to widen the road: progress was made only with the help of the soldiers whose business it was to clear the way."[6] The deep-sunk roads of this region which lent themselves so well to ambuscade became famous by the "wars of the Vendée" during the French Revolution. Today the highways have been improved, but the byways remain almost in the same state; the difficulty of transportation is ameliorated but not eliminated; it is still characteristic of western France. Physical circumstances are largely accountable: the impervious rocks hold the water, and the humid climate loosens the soil; but the slopes and hedgerows that enclose the roads are responsible in part.

## The "Bocage"

Not only the roads but the fields also are bordered by sloping banks, called *fossés*[7] in the West, which enclose them as entrenchments. Entrance to a field is only by way of its barred gate. The hedges are not simply boundary fences; each one covers considerable ground and is quite impenetrable, a little thicket—one might even say a little wood. Concerning their origin and purpose nothing is known. Whatever it may be, they present the most striking feature of the western landscape; they give it the appearance of *bocage*, that is to say country covered by thickets of trees and shrubbery. The *bocage* was formerly more developed than it is today; it is now restricted for the most part to the impermeable soils, whereas once it covered permeable soils as well, in Lower Normandy for example. The influence of physical conditions is manifest. It is, however, a particularly important point that the limit of the *bocage* coincides with that of the impermeable rocks only to the south of the Loire; to the north it cuts in two the uniform stretch of the great impervious clay-with-flints plateau. Now this limit (Fig. 1) is exactly coincident with that accounted by popular speech as the beginning of the West. To the country folk the West is essentially the region of *bocage*.

In this respect it forms a contrast with the surrounding countries. When once the border of the *bocage* is crossed the landscape is strikingly changed—

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[6] *Mémoires de l'Acad. Royale des Sci.*, Jan. 21, 1921. On the same region see Dupin: Mémoire statistique du département des Deuz-Sèvres, Paris, An. 12, p. 138. Similar testimony abounds for all parts of the West; for Bas-Maine see Musset, *op. cit.*, pp. 319–324; for Anjou, Leclerc-Thouin: De l'agriculture de l'Ouest de la France, etudiée plus particulièrement dans le département de Maine-et-Loire, Paris, 1843, pp. 170–174; for the Norman Bocage, J. Lecoeur: Esquisses du Bocage normand, Condé-sur-Noireau, 1883; for Brittany, J. Letaconnoux: Les subsistances et le commerce des grains en Bretagne au XVIIIe siècle, Rennes, 1909, p. 253.

[7] *Fossé* is literally "ditch," but in the west of France it is used in exactly the inverse sense, i. e. as "bank."

no more hedges, but a monotonous expanse of fields defined only by invisible bounds or conventional lines and stretching out to an infinite horizon. Such a country is *plaine*, a word of precisely contrary sense to *bocage*. Within the *bocage* itself *plaine* is used to describe areas free from *bocage*—whether of considerable extent, as on the permeable soils, or of limited size, as certain land used only for pasture or the ensemble of tiny fields which several neighboring farmers may have thrown together for cultivation in common.

## The Isolation of the West

Hedge-enclosed fields, scarcely traversable roads, dispersed dwellings, all contribute to the same effect. The country is parceled up to an extreme degree, and each part is isolated. Every village, hamlet, or isolated farm is sufficient to itself. To travel from his field, his hamlet, his village is a serious matter for the countryman. Occasions for meeting his fellows are rare. They are confined to Sundays, when the people go to town to hear mass or to make their purchases; and to the fairs which at long intervals enliven for a day the little towns ordinarily dead. These circumstances are reflected in the character of the people. The customary portrait of the people of the West is not altogether satirical. It is said that they are suspicious of the new and strange; they avoid or receive with reluctance the outsider, *le horsain* or *le hors-venu*, as the Normans call him; they reject innovations, clinging tenaciously to the traditional. A French writer, M. Siegfried, in a penetrating study [8] has shown how the political life of the West, this stronghold of French conservatism, is in sum the consequence of geographical conditions.

## Subdivisions of Western France

Uniform as a whole, subdivided to an extreme degree in detail, markedly different from the surrounding regions—such is western France. Within it one cannot recognize any natural regions, or *pays*, as in the Paris Basin for example.[9] Here the only living unit is the village. Only on the border can *pays* be distinguished by contrast with the country beyond: the *pays* of Auge, lying between the clay-with-flints plain on the east and the plains of Lower Normandy on the west; the Perche, defined by contrast with the neighboring plain of Beauce.[10] As to the names "Bocage normand" and "Bocage vendéen," they are only general terms applied without any precise limits. The old names of provinces—Normandy, Maine, Anjou, Brittany, Poitou—are of historic origin and have no true geographical significance. Other old territorial divisions of vague bounds are occasionally preserved by local tradition—Léon, Cornouaille, Broweroch—but often they have entirely fallen out of use, as in Brittany those of Penthièvre, Trégorrois, and Porhoet.

Yet certain parts of the landscape detach themselves from the general

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[8] André Siegfried: Tableau politique de la France de l'Ouest sous la Troisième République, Paris, 1913. See the review by Paul Vidal de la Blache, *Ann. de Géogr.*, Vol. 23–24, 1914–15, pp. 261–264.

[9] See Lucien Gallois: Régions naturelles et noms de pays: Étude sur la région parisienne, Paris, 1908.

[10] René Musset: Le Perche, nom de pays, *Ann. de Géogr.*, Vol. 28, 1919, pp. 342–359.

picture by virtue of some trait of individuality. Such are the rare *plaines* occurring in the midst of the *bocage;* the *plaines* of Caen and Argentan, the champaign of Alençon, the plain or *bas-pays* of the east of Cotentin; the valleys of the larger rivers with alluvial floors devoted to market gardens and slopes given to vine cultivation, to which the term *val* is usually applied—val d'Anjou, val de Loire, val du Loir—and, in Anjou, that curious valley of the Authion known simply as "la Vallée;" the low, marshy regions along the coast now more or less drained (*marais*)—the marshes of Carentan to the south of Cotentin, of Dol in Brittany, the Breton and Poitevin marshes in Vendée. And finally there is a distinction born of proximity to the sea. In Brittany, where the extreme indentation of the shore line has intensified maritime pursuits the narrow littoral band shows a distinctive type of life; the people are both farmers and sailors. The farmer keeps the typical traits of the West; the sailor, engaged in navigation and fishing, makes outside contacts to which he succumbs in the end though he may be mistrustful in the beginning. Thus is created the difference between maritime Brittany, or Armor (the country of the sea), open to the outside world, and interior Brittany, or Arc'hoat (the wooded country), the most backward part of the entire West.[11]

## Recent Changes

The picture we have drawn is in process of transformation. This is especially so in respect of agricultural development.

Nothing could be more monotonously uniform than the old-time agriculture of the West; a single system prevailed throughout the region. Land was divided into two parts, the fields devoted to crops, far the less extensive in area, and the "idle" land which included the fallow fields and the pastures. The fallow fields were left for 2 or 3 or 10 years and 15 or 20 years; while the pastures consisted of the *landes*, deforested areas never cultivated. As the soil is naturally deficient in plant foods and lacks the two essential elements, lime and phosphoric acid, only the inferior cereals could be grown, barley, rye, oats, and buckwheat, from which was made a coarse bread eaten as sops or in thin cakes. The animals for lack of phosphate of lime were undersized though hardy. This inferior agriculture had but one object, to provide for the needs of the people themselves, and for this it did not always suffice. The West was too isolated and subdivided to engage in foreign commerce; the sole export was cattle in limited number—the only product, as an old writer has said, "that could transport itself."

But towards the middle of the nineteenth century the opening up of the West began. The central administration of France paid careful regard to the development of communications, constructing roads and railways and bringing the various regions of the country in touch with each other and with the outside. This was the point of departure for a complete revolution

[11] Emmanuel de Martonne: The Real France, *Journ. of Geogr.*, Vol. 18, 1919, pp. 81–94.

in agricultural methods. The soil was enriched by the addition of lime and fertilizers; wheat began to replace rye and to make inroads on the acreage planted to other cereals. The West, which till then had asked only its daily bread and had cultivated grain in preference to raising cattle, now began farming for export and concentrated its efforts on those products it could sell to the best advantage; it turned to its natural vocation, cattle raising favored by the good pasturage of this humid land.

The agricultural transformation of the West has tended to give the region a diversified aspect unknown before. The movement began at different times in different parts, and not all regions have progressed at the same pace. On the whole the change commenced on the eastern border and traveled westward; it has been completed in Normandy, Perche, Maine, and almost all Upper Brittany; it is in progress in the Norman Bocage and the north of Cotentin; it has scarcely begun in Lower Brittany, where there are great stretches of *landes* and fallow fields.

Nor has transformation everywhere followed the same course. The uniform agriculture of former times has given way to different adaptations in different places—on the border, within the *bocages*, on the *plaines*. Live stock is bred in the *bocage* and fattened on the *plaines*. Thus the young animals, horses and cattle, raised in Cotentin, the Norman Bocage, and Bas-Maine are sent to the *plaines* of Lower Normandy; those of Vendée to the *plaines* of Haut-Poitou and Charentes; the Perche is similarly associated with the Beauce in the raising of horses. The building of railways has permitted the extension of such relations. Cotentin, the Norman Bocage, Bas-Maine, Anjou, Vendée, and certain corners of Brittany ship young animals long distances. Bas-Maine, for instance, sends cattle to be fattened into Poitou, northern France, and even Belgium; Léon, in Brittany, sends foals to the plain of Valence whence they are finally sold to the vine-growing regions of the Midi. The most important branch of the pastoral industry, cattle raising, is specialized into three distinct types. Such sections as Perche, Cotentin, the Norman Bocage, Bas-Maine, northern Anjou, and Vendée are interested primarily in the breeding of animals to be sold while young. In other sections, devoted to dairying, stock is largely limited to milch cows; such is Brittany, a great producer of milk and butter. Other areas—the *pays* of Auge, the region of Merlerault, the *plaines* of Lower Normandy—combine dairying with the fattening of cattle; southern Anjou and Mauges have almost entirely specialized in the latter. In the West generally the raising of meat cattle is on the increase.

## Conclusion

Present-day evolution is tending to a profound modification of the life of western France, making of it a region less isolated and less uniform. The process, however, is far from being complete; it has transformed only the economic life and this not everywhere to the same extent; certain remote

the people as a whole, molded by centuries of isolation, is

In France the West represents the conservative, tradition-

accepting material progress but jealously retentive of the

of thought and action.

# CLIMATIC PROVINCES OF THE RUSSIAN FAR EAST IN RELATION TO HUMAN ACTIVITIES

By Stanislaus Novakovsky

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In the extreme northeast of Siberia fish takes the place of bread. A fish famine brings the same dire results there as a bread famine in Europe. A large proportion of the population is engaged in fishing. In the success or failure of the industry climatic conditions play a considerable part. A fog in London may deprive many people of pleasure and may have some slight effect on retail trade and the stock exchange, but in far northeastern Siberia fogs may spell disaster to many hundreds of people. In this area the greater part of the summer is characterized by cloudy or foggy days which not only reduce the catch but are unfavorable to its preservation. The lack of salt and the primitive methods of salting compel the fishers to resort to sun-drying. But drying of the fish must take place in the second half of July and in August when clear days are few and far between. Fortunately, however, as if in compensation for this niggardliness Nature sends cold weather early, thus providing an alternative method of preservation—by freezing.

Besides cloudiness there are other climatic factors which militate against the fishing industry—the long winter, the freezing of the harbors and closure of navigation, the autumn cold spells, and the strong winds. The effect of such conditions might be indicated for other branches of industry. What they are and how they affect different parts of the great region known as the Russian Far East it is the purpose of this article to describe.

## Dominant Factors in the Climate of the Russian Far East

The Russian Far East comprises the four administrative provinces of Amur, Primorskaya (Maritime Province), Sakhalin, and Kamchatka. The territory covers an area of approximately 937,000 square miles, three and a half times the size of Japan.

The territory forms a longitudinal strip extending from within the Arctic Circle to about the latitude of New York and lying between the greatest body of water in the world and the greatest land mass. It is dominated by winds of a monsoonal type. The easterly and southeasterly winds of summer bring the greater part of the rainfall, the westerly and northwesterly winds of winter bring dry cold. The pole of winter cold, in northeastern Yakutsk Province, is not far distant. On the other hand the region is clearly distinguished from the Siberian interior by modification of continentality, partly due to proximity to the sea, partly to the relief. In respect of the influence of

the sea, note should be made of the dominantly cold currents originating in the Sea of Okhotsk, in which floating ice is found the greater part of the year. The warm Kuro-siwo has very limited effect in the region.

As a whole the relief of the region is considerable. The Stanovoy and Khingan Ranges constitute a barrier against the cold winds of the Asiatic interior and limit the zone in which is felt the moderating influence of the sea. In detail the effect of the orography is seen in the pronounced local variations in climate. Some of the sheltered valleys are warm and, accumulating a deep snow cover in the winter, have a warm soil also. In others the phenomenon of temperature inversion is pronounced. A local influence is also exerted by the cover of *taiga*, the damp, tangled Siberian forest. The diurnal effect, higher night and lower day temperatures, is quite appreciable, and there is also a slight seasonal modification of temperature.

The several climatic regions into which the Russian Far East can be subdivided will now be described.

## The Anadyr-Chukotsk Region

The Anadyr-Chukotsk region covers an area of 222,000 square miles and consists of three parts, the southern part or basin of the Anadyr, the northern, practically uninhabited and scarcely known save along the Arctic shore, and the eastern peninsula, Chukotsk (Chukchi). The relief of the Anadyr subregion is very diversified. A central depression is flanked on the west by a branch of the Stanovoy Range; on the east appear the harsh crest lines of the range extending north from Kamchatka. In the northern and eastern regions are long ranges, disorganized groups of mountains, plateaus, and hilly lowlands. The ranges, however, do not attain any great elevation, and relief here lacks the significance that attaches to it elsewhere in the Russian Far East.

Data on climate are scant. We have records from the stations of Markovo, 200 miles up the Anadyr, and Novo-Mariinsk at the river mouth, and the coastal strip is known to some extent from the observations of travelers and navigators, Nordenskiöld and Bogdanovich in particular. The general opinion of travelers is expressed in the words of Captain Billings[1] who explored the Chukotsk peninsula from Bering Strait to Nijnekolymsk towards the end of the eighteenth century: "The land of Chukchi is nothing but a mass of naked stones; its climate is most unbearable, nothing like summer until the 20th of July, and about the 20th of August the approach of winter is noticeable." The climate of this northern extremity of Asia cannot, however, be dismissed in quite so summary a fashion; though it is true that it is distinguished by its severity and arctic character, as observations at the meteorological stations show.

The mean annual temperature of Novo-Mariinsk is −7.9° C. (17.8° F.); Markovo is more extreme and has a still lower average for the year, −9.1° C. (15.6° F.).

[1] G. Sarychev: Journey of Captain Billings through Chukchis Land, St. Petersburg, 1811.

CLIMATIC REGIONS
1 ANADYR-CHUKOTSK
2 KAMCHATKA
3 OKHOTSK
4 RUSSIAN SAKHALIN
5 MARITIME
6 AMUR
7 USSURI
RUSSIAN FAR EAST
200 0 200 400 600 800 KILOMETERS
100 0 100 200 300 400 500 MILES
METERS
FEET
2000
6560
1000
3280
500
1640
THE GEOGR. REVIEW, JAN. 1922
180
170
160
70
60
50
40
120
130
140
150
BERING SEA
Anadyr
Novo Mariinsk
Markovo
Petropavlovsk
SEA OF OKHOTSK
Okhotsk
Ayan
Nikolaevsk
Amgun
Amur
GULF OF TARTARY
Alexandrovsk
SAKHALIN
Imperator Hbr.
Khabarovsk
Blagovyeshchensk
Amur
Zeya
Bureya
BUREYA MTS.
GREAT KHINGAN MTS.
LITTLE KHINGAN MTS.
Lake Khanka
Sungari
Ussuri
SEA OF JAPAN
Vladivostok

FIG. 1

# TEMPERATURE AND RAINFALL OF THE RUSSIAN FAR EAST

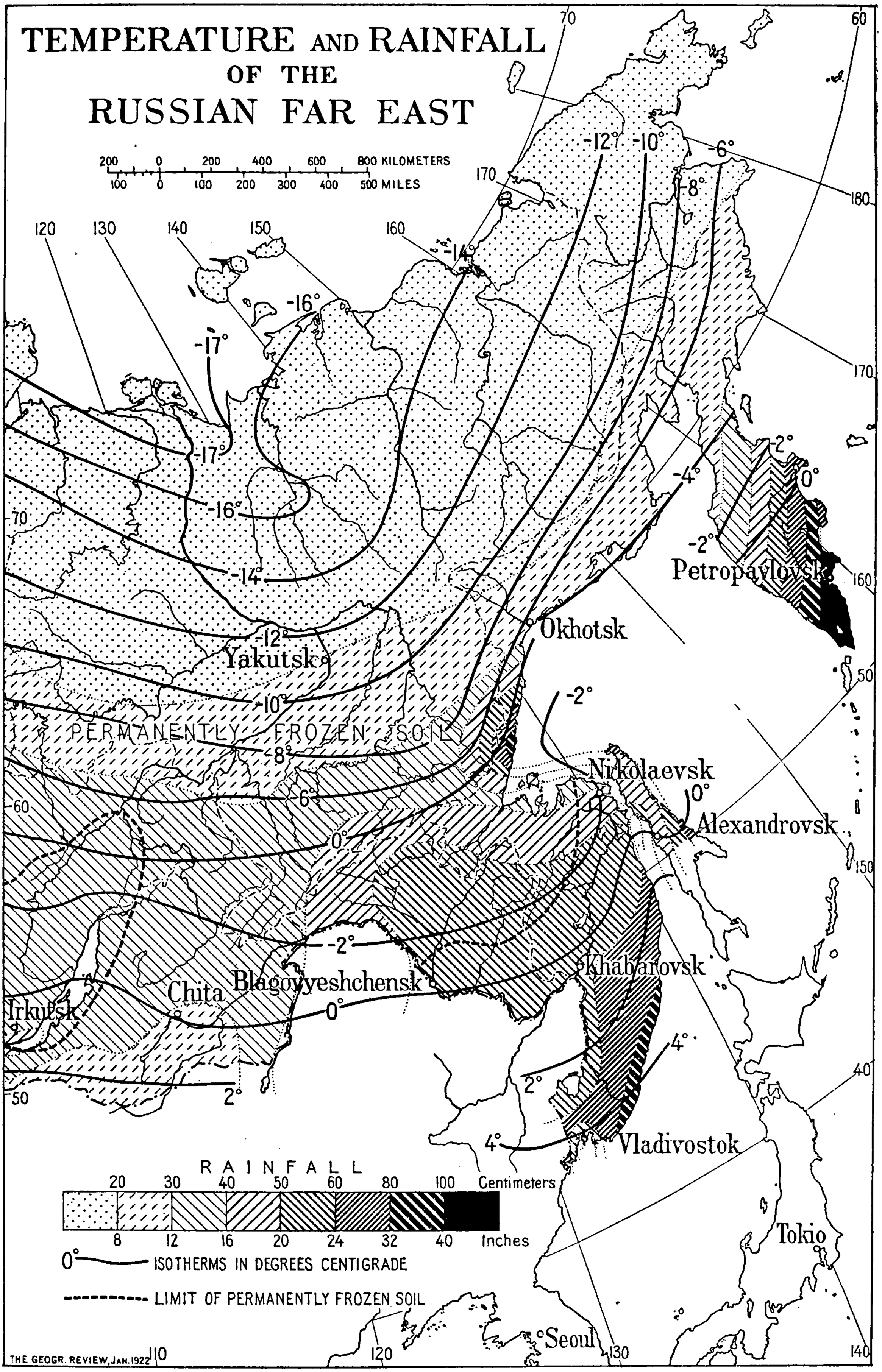


FIG. 2

TABLE I—MEAN MONTHLY AND ANNUAL TEMPERATURE IN THE RUSSIAN FAR EAST

(*In degrees Centigrade*)

| STATIONS | LATITUDE | LONGITUDE | YEARS OF RECORD | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANADYR-CHUKOTSK REGION | | | | | | | | | | | | | | | | |
| Novo-Mariinsk . . . . | 64°45′N. | 177° E. | 6 | −22.6 | −24.9 | −20.0 | −13.4 | −2.9 | −4.9 | 11.2 | 9.3 | 3.7 | −5.0 | −14.8 | −20.9 | −7.9 |
| Markovo . . . . . | 64°45′ | 170°50′ | 9 | −30.1 | −27.1 | −21.2 | −13.8 | −2.3 | 10.3 | 14.2 | 10.5 | 3.2 | −8.3 | −19.6 | −25.1 | −9.1 |
| KAMCHATKA REGION | | | | | | | | | | | | | | | | |
| Petropavlovsk . . . . | 52°53′ | 158°47′ | 8 | −10.8 | −11.3 | −7.5 | −1.6 | 2.8 | 7.4 | 11.5 | 12.3 | 9.6 | 4.0 | −2.3 | −5.8 | 0.7 |
| OKHOTSK REGION | | | | | | | | | | | | | | | | |
| Okhotsk . . . . . | 59°21′ | 143°17′ | 5 | −23.1 | −22.4 | −15.0 | −6.4 | 0.7 | 6.1 | 12.4 | 12.1 | 7.8 | −2.7 | −14.5 | −20.7 | −5.5 |
| SAKHALIN REGION | | | | | | | | | | | | | | | | |
| Alexandrovsk . . . . | 50°54′ | 142°10′ | 20 | −19.5 | −15.7 | −9.7 | −0.4 | 5.1 | 10.7 | 15.9 | 16.2 | 12.0 | 3.9 | −5.4 | −13.1 | 0.0 |
| NIKOLAEVSK REGION | | | | | | | | | | | | | | | | |
| Nikolaevsk . . . . . | 53° 8′ | 140°43′ | 19 | −24.5 | −20.5 | −12.0 | −1.8 | 4.0 | 11.4 | 17.1 | 16.1 | 11.7 | 2.2 | −9.0 | −19.1 | −2.0 |
| AMUR REGION | | | | | | | | | | | | | | | | |
| Blagovyeshchensk . . | 50°16′ | 127° 0′ | 10 | −24.0 | −18.7 | −9.0 | 2.5 | 10.5 | 17.6 | 21.3 | 18.9 | 12.6 | 1.2 | −9.8 | −20.6 | 0.3 |
| Cherniaevo . . . . . | 52°47′ | 126° 0′ | 5 | −27.5 | −21.5 | −12.3 | 0.5 | 9.5 | 16.5 | 19.3 | 17.0 | 10.3 | −2.4 | −16.2 | −24.3 | 2.6 |
| USSURI REGION | | | | | | | | | | | | | | | | |
| Khabarovsk . . . . . | 48°28′ | 135° 7′ | 8 | −23.4 | −18.7 | −9.2 | 3.0 | 11.0 | 17.4 | 21.2 | 20.0 | 13.2 | 4.0 | −7.7 | −18.5 | 1.0 |
| Vladivostok . . . . . | 43° 7′ | 131°55′ | 20 | −13.8 | −10.3 | −2.7 | 4.9 | 10.0 | 13.9 | 18.6 | 21.0 | 16.8 | 8.8 | −0.1 | −9.3 | 4.9 |

TABLE II—MEAN MONTHLY PRECIPITATION IN THE RUSSIAN FAR EAST

(*In millimeters*)

| STATIONS | YEARS OF RECORD | JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANADYR-CHUKOTSK REGION | | | | | | | | | | | | | | |
| Novo-Mariinsk | 7 | 9.6 | 4.9 | 6.3 | 9.0 | 9.0 | 29.4 | 43.7 | 53.6 | 41.5 | 34.1 | 19.9 | 13.2 | 272.9 |
| Markovo | 11 | 7.6 | 6.6 | 7.2 | 3.9 | 5.2 | 22.9 | 33.3 | 36.8 | 29.4 | 11.7 | 8.8 | 8.3 | 181.8 |
| KAMCHATKA REGION | | | | | | | | | | | | | | |
| Petropavlovsk | 10 | 60.4 | 50.4 | 51.1 | 49.3 | 63.1 | 66.7 | 73.0 | 119.7 | 100.9 | 130.4 | 85.4 | 59.3 | 920.9 |
| OKHOTSK REGION | | | | | | | | | | | | | | |
| Okhotsk | 4 | 1.7 | 1.1 | 4.0 | 16.6 | 19.5 | 52.5 | 50.9 | 25.5 | 36.3 | 24.0 | 2.8 | 4.9 | 236.8 |
| SAKHALIN REGION | | | | | | | | | | | | | | |
| Alexandrovsk | 5 | 49.0 | 24.8 | 54.0 | 32.4 | 34.8 | 23.0 | 53.0 | 42.8 | 89.5 | 96.8 | 30.2 | 60.8 | 591.1 |
| NIKOLAEVSK REGION | | | | | | | | | | | | | | |
| Nikolaevsk | 16 | 24.0 | 15.5 | 21.1 | 35.0 | 29.7 | 29.5 | 51.3 | 82.8 | 66.1 | 66.3 | 38.3 | 28.4 | 496.1 |
| AMUR REGION | | | | | | | | | | | | | | |
| Blagovyeshchensk | 5 | 3.9 | 0.3 | 1.8 | 16.4 | 52.5 | 67.9 | 135.2 | 122.2 | 98.5 | 29.8 | 5.6 | 1.8 | 535.9 |
| Cherniaevo | 6 | 2.5 | 2.5 | 5.1 | 14.1 | 43.3 | 54.9 | 91.1 | 100.5 | 34.7 | 15.9 | 7.2 | 6.2 | 378.3 |
| USSURI REGION | | | | | | | | | | | | | | |
| Khabarovsk | 4 | 4.1 | 7.2 | 10.2 | 23.0 | 61.4 | 100.5 | 107.1 | 113.9 | 54.5 | 36.3 | 14.8 | 11.5 | 544.6 |
| Vladivostok | 18 | 6.1 | 7.9 | 11.3 | 25.8 | 53.0 | 63.2 | 74.1 | 132.9 | 108.8 | 45.4 | 13.4 | 11.6 | 554.5 |

Spring and autumn are so short that only two seasons can be properly recognized, winter which lasts nine months and summer lasting three months. This explains the fact that nearly all the soil of the region is permanently frozen, never thawing to a depth of more than 20 to 40 centimeters below the surface.

Though precipitation is small (10 inches in Novo-Mariinsk, 7 inches only in Markovo), humidity is high; and the percentage of cloudy and foggy days is very great. The average for many years gives Markovo only 63 clear days a year, Novo-Mariinsk, 69. In general only one month in Markovo (July) and two in Mariinsk (July and August) are free from snowfall; but the number of snowy days is not great—for the former station it averages 72, for the latter 71—nor is the fall heavy. The River Anadyr is ice-free for about four months, mid-June to mid-October.

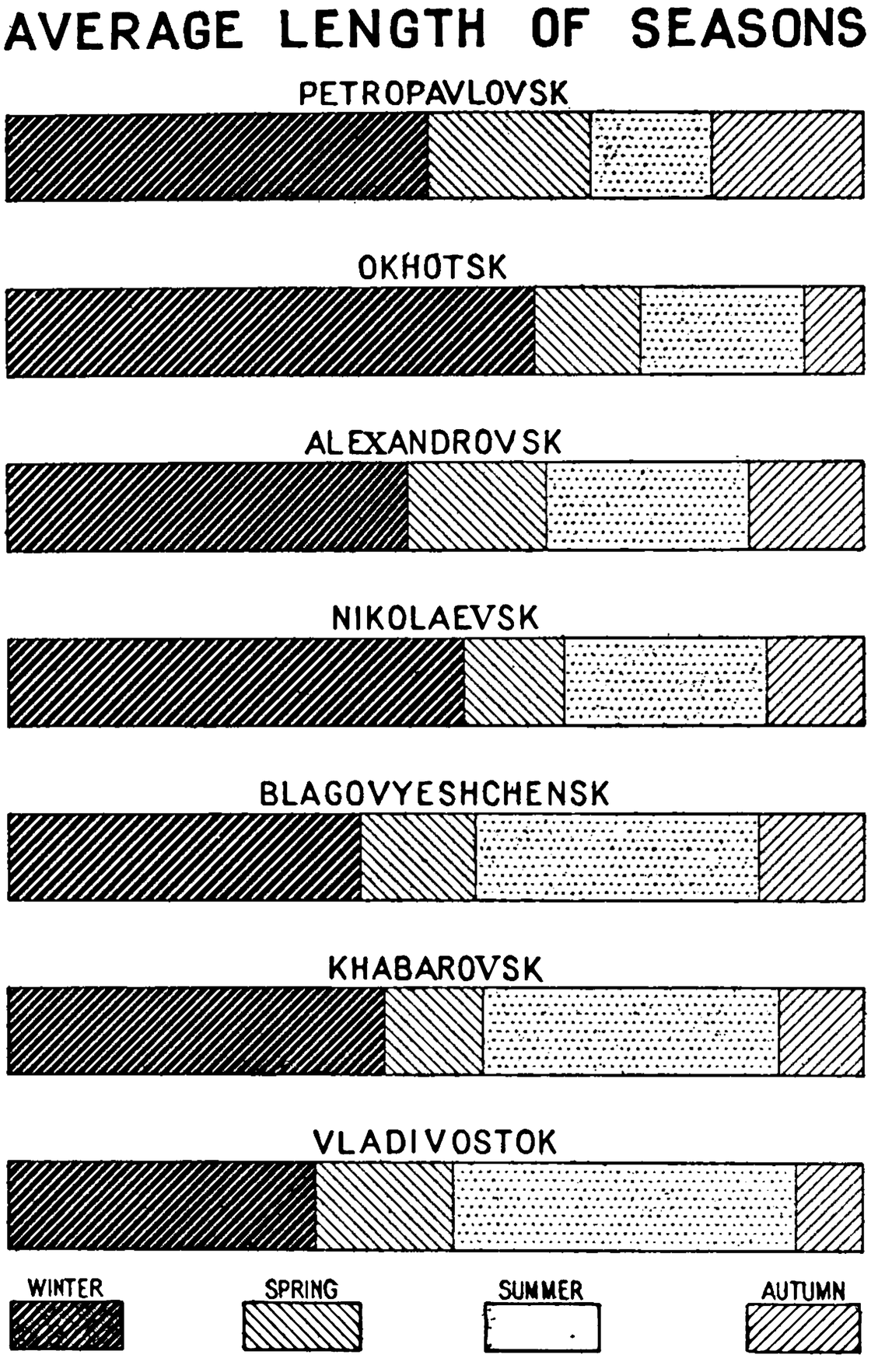


FIG. 3—Average length of seasons in the Russian Far East.

The vegetation is naturally feeble and scant. In the more westerly part and the middle of the Anadyr basin there is a stunted forest growth, chiefly poplar, alder, and larch. A sizable broad-leaved forest is found on the mountain slopes upstream of the Anadyr and its tributaries. In general the boundary line of the forested area may be placed at 169° E. longitude. Eastward is tundra, frozen in winter, swampy in summer. Forest growth is in part restricted by the powerful destructive winds that carry masses of frozen snow mixed with sand and exercise a marked scouring effect on the rocks.

At Markovo the frost-free period ranges from 65 to 90 days, and the vegetative period is correspondingly short. The period of active growth is considered as that with the average daily temperature reaching 6° C. (43° F.) or more. At Markovo it extends from June 4 to September 10, and the total of heat units (total of average daily temperatures above freezing point) for this period is 1,204. Now 1,000 heat units are sufficient for agriculture in some circumstances, but here there are other unfavorable conditions—the high degree of humidity, and cloudiness, the number of rainy days in the summer season, the cold winds. Inhabitants of Markovo have attempted to grow vegetables, but the results were not worth the time and trouble that

had to be expended. The basis of life in this region depends upon the sea fisheries, hunting, and reindeer breeding.

## The Kamchatka Region

The Kamchatka region includes the peninsula of that name and the adjacent islands. The northern part of the peninsula is plateau diversified by hills and open to the influence of the Bering and Okhotsk Seas. The rest of the region is characterized by two parallel ranges of volcanic mountains running its length and separated by the wide valley of the Kamchatka River.

The climate of Kamchatka is distinctly milder than that of the Anadyr-Chukotsk region. Winter lasts 6½ months instead of 9, and there is a comparatively long spring. The mean annual temperature (for an eight-year period) of Petropavlovsk is 0.7° C. (33° F.).

Orography and the direction of the prevailing winds—westerly in winter and easterly in summer—clearly differentiate the eastern and western coasts. However, they may both be described as having a semioceanic climate, while the shut-in central section is semicontinental and the exposed north cold continental in character. The lowest mean monthly temperature of Petropavlovsk (February) is −11° C. (12.2° F.), and the minimum −20.4° C. (−4.7° F.); the highest monthly mean (August) is 11.7° C. (53° F.), and the maximum 26° C. (78.8° F.). Petropavlovsk is on the eastern shore, and its temperature appears to be influenced to some extent by a drift (Kamchatka Current) from the warm Kuro-siwo. Bolsheretsk on the western shore is colder, while Kluchevskoye in the interior is still more extreme. The lowest mean monthly temperature at the latter (January) is −18.2° C. (−0.7° F.), and the minimum (February) −36.3° C. (−33.3° F.); the highest monthly mean (July) is 12.1° C. (53.7° F.), the maximum (June) 24.9° C. (76.8° F.).

Precipitation in the Kamchatka region is comparatively heavy and is more equably distributed through the year than in any other region of the Far East. Fifty per cent of the fall is as snow. Indeed, the peninsula is renowned for its violent snowstorms. The huge snowdrifts do not melt until late in the year. The fishermen, who gather about the middle of May to resume fishing, often find their stations completely snowed under. A cold and snowy winter, however, is frequently followed by bright sunny days, especially in March which is the most convenient month for making trips over the country. The rather considerable heat of the sun alternating with the night cold helps to form a solid crust of ice on the surface of the snow, thus facilitating driving. "During this season," says Ditmar,[2] "all the localities of the peninsula seem to be drawn closer together, as the distance between them is more rapidly covered."

The Petropavlovsk section of Kamchatka is situated in the same latitude as Samara, the great wheat-growing region of the middle Volga, but experi-

[2] K. Ditmar: Kamchatka, St. Petersburg, 1901.

ments in cereal production in the former district have proved failures. While the grain reaches a formidable height, the ears form very late and are either caught unripened by the frosts or ripen in September to a poor yield. The total of heat units for the vegetative period, May to September, is 1,507 for Petropavlovsk and 1,651 for Kluchevskoye, but the destructive frosts of late spring and early fall, the clouded skies of summer, and the high humidity are deterrent.

On the basis of climate and topography the natural vegetation of the peninsula may be subdivided into coastal and inland types. In the former, shrubs and tundra predominate; in the latter, conifers. The meadows with their luxuriant grasses furnish good grazing for cattle.

## The Okhotsk Region

The Okhotsk region is a narrow strip along the northern and western shores of the Okhotsk Sea extending from the border of the Maritime Province to the northwestern corner of Kamchatka. It is cut off from the neighboring regions by the Aldan Mountains, the numerous branches of which give the coastal region a hilly character everywhere except in the north. The considerable relief in combination with the effect of the cold waters of the Okhotsk Sea make the climate abnormally cold and damp for its geographical position. The mean annual temperature of Okhotsk (town) is −5.5° C. (22° F.). The presence of masses of floating ice along the shores lowers the temperature of spring and summer. The former season is much shorter here than in Kamchatka, shorter even than in the Anadyr-Chukotsk region. Associated with the coldness of the sea waters is the prevalence of foggy and cloudy days. Thus in 1915 the town of Okhotsk had only two clear days in June, none in July, seven in August.

The winter is very cold, fairly snowy and stormy, and at times subject to spells of extreme cold. Autumn also is short and cold. Very low minima are observed even in October; for example in 1915 the October minimum for Okhotsk was −21.3° C.

Although the number of heat units received during the vegetative period, June to September, is not inconsiderable—1,057 for Okhotsk—the same unfavorable factors, principally lack of direct sunshine, operate as in the Kamchatka and Anadyr-Chukotsk regions and preclude all possibility of agriculture beyond the raising of certain vegetables.

The humidity of the climate, to which the slow thawing of the snow on the mountains and the *taiga*-covered slopes appear to contribute, is especially unfavorable. Heavy dews are experienced in the late summer and early autumn. The effect of the unusually high degree of moisture in the air has been described by Dr. Slunin:[3] "On the steep banks eroded by the river in its course there hung on every leaflet and stalk, as well as on the roots of shrubs and plants, beads of silvery dew refracting the rays of the morning

[3] N. Slunin: Okhotsk District and Kamchatka, St. Petersburg, 1900.

sun in the colors of the rainbow. Large glittering drops fell from every peat mound. The whole tundra, as they say, was weeping. As you glide down a river in a canoe, you meet with the like enchanted scenery for miles and miles and day after day. We were sometimes driven desperate by the unbearable moisture of the air."

The open exposed plain of the extreme north of the region is tundra; the remainder of the country is largely covered with *taiga* in which the trees, especially near the coast, are deciduous for the most part—birch, poplar, and alder. The influence of the wind on forest growth is most pronounced. In sheltered valleys tall fine trees are found; in exposed places they are stunted and twisted to an extraordinary degree.

The general poverty and monotony of the region is such that one cannot but admire the inventiveness of the native in his utilization of the natural resources. From a nettle the Koryak and Kamchadale manufacture a kind of hemp; from the sea grass, one of the most luxuriant features of the flora, they braid bags and mats; a species of alder gives material for the dyeing and tanning of reindeer hide.

## The Sakhalin Region

The island of Sakhalin stretches as a long narrow band along the eastern shore of the Maritime Province, being separated from it by the northern part of the Japan Sea. The rorthern part of the island, that belonging to Russia, has an area of about 15,000 square miles. The island is traversed by a series of meridional mountain ranges. The first of these ranges stretches from the northern tip of the island to latitude 51° 21′, from which point southward the inner part of the island is lowland, the basin of the Tymy River, the largest river of Russian Sakhalir. Flanking the central lowland are western and eastern coastal ranges. Nowhere is the elevation great. Even the highest peaks of the Eastern Coastal Range do not rise over 3,000 feet.

The climate of Sakhalin, generally speaking, is cold and humid, especially on the coasts. Alexandrovsk on the west coast has a mean annual temperature of 0.° C. This coast, facing the Straits of Tartary, is somewhat milder than that of the east, facing the Sea of Okhotsk, and appears to show the influence of a branch of the Kuro-siwo diverted thither from the stream passing through La Pérouse Strait.

The average annual precipitation in Sakhalin is about 600 millimeters (24 inches) and, like that of Kamchatka, is well distributed through the year though still heavier in the summer and autumn. The summer rains are noted for their intensity. Snow falls eight months of the year, from October to May.

Heat units during the vegetative period at Alexandrovsk, April 27–October 2, amount to 1,934; but the same objectionable factors are present as in the Okhotsk region. In particular mention should be made of the salt

sea fogs of the coastal regions. The sheltered valley of the Tymy is, however, more favorably circumstanced.

The considerable variation of climate throughout the length of Russian Sakhalin, 900 miles, is well reflected in the vegetation. Tundra occurs in the north; but nine-tenths of the island is wooded, and the southern portion has a rich variety of species, northern and southern forms mingling. In the latitude of Alexandrovsk the Kurilian bamboo is found. The vegetation appears to be richer for the most part on the mountain slopes facing the Straits of Tartary, much poorer on the slopes exposed to the Okhotsk Sea. Emphasis must be laid on the effect of local conditions. The estuary of Poronay (in Japanese territory), lying in an exposed situation, has a typically arctic flora; while in the extreme north are sheltered spots where tundra is replaced by trees.

## The Nikolaevsk Region

The Nikolaevsk, or Udsk, region is coincident with the administrative subdivision of Uda, the main portion of which in 1914 was separated from the Maritime Province and temporarily placed under the local Sakhalin government. A large part of the region, particularly north and west of the Amgun, is practically unknown country. The area of the region is about 38,000 square miles, and it is very scantily populated. In 1909 there were only 13,749 souls of whom 12,700 lived in the city of Nikolaevsk. The relief is generally mountainous, though there are several extensive depressions. A continuation of the Little Khingan of northern Manchuria traverses the southern part of the region as the Bureya range and reaches altitudes of 3,000 to 5,000 feet above sea level. In the north are ramifications of the Stanovoy Range. The most important lowland is that of the Lower Amur which in its central part attains a width of 100 miles.

The climate of the best known part of the region is subject to influences similar to those obtaining in the Okhotsk region. The winter is severe and lasts almost half the year. Spring and summer are late and short especially near the coast, washed as it is by ice-laden currents. Thanks to the presence of the sea, however, the autumn is warmer along the shore and may be considered the best season of the year.

There is considerable local variation in temperature. Layers of cold air tend to accumulate in the depressions and flow along the river courses. For this reason the Amur valley stays very cold. During January the average temperature of Nikolaevsk drops to −24.5° C., while Ayan, situated farther north, has a temperature 6° higher. The length of the winter, with closing of the Lower Amur to navigation from the end of October until the middle of May, has been deterrent to the growth of Nikolaevsk; while its rival Vladivostok, climatically better favored, has succeeded. Of course other circumstances have also hampered development of the port—the bar at the mouth of the Amur, the lack of railroads and general backwardness of the hinterland, and military contingency. The mean monthly temperature is the same for the two stations, −2° C. (28° F.).

The rainfall is typically distributed. Thus in 1914 the total precipitation for Nikolaevsk during the six cold months was 88 millimeters (3.5 inches), for the six warm months 231 millimeters (9 inches). Other stations in the region show a more marked seasonal difference. Thus for Mariinsk, up the Amur, the seasonal distribution was 64 millimeters (2.5 inches) and 441 millimeters (17 inches) respectively. Unlike the case in the Okhotsk region fogs are of infrequent occurrence here.

The comparatively high temperatures of summer and autumn suggest possibilities of agriculture. At Nikolaevsk the total of heat units for the period of active growth is 1,752; the figure is higher for southern parts of the interior. The inhabitants of Novo-Sergievskoye, a village a few miles from Nikolaevsk supply themselves entirely with grain and sow fall rye and barley. Within a radius of some 100 miles from Nikolaevsk almost all kinds of grain ripen—rye, oats, and wheat; and 150 miles north of Khabarovsk even watermelons ripen well. Thanks to the industry of its Korean gardeners the city is supplied with home-grown vegetables in excess of its needs, and in recent years the surplus has been shipped south to Khabarovsk and Blagovyeshchensk.

## The Amur Region

The Amur Province occupies an area of some 155,000 square miles. Across the northern part stretch the Stanovoy Mountains. The range, which here has a latitudinal direction, constitutes the boundary between the Yakutsk and Amur Provinces. The average height of the summits approximates 3,500 feet, individual peaks reaching 7,000 feet. From Manchuria the Great Khingan Mountains enter the southwestern corner of the region, forming the boundary between this province and that of Transbaikal. In the eastern part the Buryea Mountains continue the Little Khingan. Several minor ranges diversify the topography. One feature that claims special note is the Zeya-Buryea lowland covering an area of 65,800 square miles along the Amur and the lower courses of its tributaries from the Zeya eastward to the Buryea ranges. It is sometimes known as the Upper Amur prairie, is fairly well populated, and offers good prospects for agriculture.

The climate of the province is markedly continental, average and absolute ranges being great. In Blagovyeshchensk the absolute range for 1914 was 64.6°, i.e. from −34.9° C. (−30.8° F.) in January to 29.7° C. (85.5° F.) in August. It is still greater in other sections in the northwest: Dambuki registers −53° C. (−63.5° F.) in January, 30.8° C. (87.4° F.) in July. Though there are local differences, over the broad area of the province considered as a whole there is a noteworthy uniformity, and the climatic type is distinctive. Thus for a number of widely dispersed stations the extreme difference in length of winter is only 19 days, ranging from 205 to 186 days. Everywhere winter cold is intense and uniformly maintained without sharp fluctuations and accompanying thaws. Thickness of ice on the Amur reaches from three to eight feet in January.

The distribution of snow is very irregular; but in general the fall is light—only four per cent of the precipitation—and the snow is fine and powdery and easily blown away. In some parts of the country sleds are not used, whereas over most of Siberia they afford the chief means of winter transportation. Lacking a snow cover the rivers freeze to the bottom, the earth cracks in big fissures, and winter crops perish. In places the soil freezes to depths of seven or eight feet and thaws slowly so that spring sowing is delayed. It is not surprising that permanently frozen soil is encountered in many parts of Amur Province, whereas in Sakhalin the phenomenon is unknown. The problem of permanently frozen soil is a complex one. According to the authority Professor Yachevsky it involves not only low air temperatures and deficient snow cover but geological and hydrographical conditions as well. With the coming of warm days the whole character of the weather changes sharply. Though the winds still come prevailingly from the west, they are less regular; the number of cloudy days increases as does precipitation; sometimes there are fogs. In contrast with the uniformity of winter is the inconstancy of spring. The most unfavorable phenomenon is the late frosts. Near Blagovyeshchensk they continue to mid-May, and longer farther north.

The distribution of rainfall is typical. It is greater in the east than in the west, but everywhere Amur Province shares with the monsoonal lands of eastern Asia the preponderance of summer rain. At Blagovyeshchensk 85 per cent falls in summer and autumn.

On the question of the suitability of the climate for agriculture there are differences of opinion. The short autumn and long winter with low temperatures and freezing of the soil preclude fall sowing in most of the area. On the other hand, the summer averages about three months. At Blagovyeshchensk the total of heat units is 2,380. On the other hand summer rains hinder the ripening of grain; the heavy falls of rain do not readily drain off, and plants tend to rot. The barriers to agricultural development do not appear to be insurmountable, however. Much could be done by improvement of methods of cultivation and the selection of suitable seed. It may be noted that the practice of burning the forests helps to create a "dry fog," a phenomenon of common occurrence from May to August.

The table on the next page shows the yield in 1911 of certain crops in Amur Province compared with yield in interior eastern Siberia and European Russia in the same latitude.

The natural vegetation of the Amur Province is rich and diversified. Though the climate is markedly uniform, subregions may be recognized based on the vegetation:

1. Southwestern section characterized by the eastern larch (*Larix daurica*) and with steppelike meadows on the drier mountain slopes.

2. Northwestern section with the eastern larch and the white birch and occasionally pine and more rarely fir.

3. Southeastern section with Manchurian flora predominating, and

including the Manchurian cedar, oak, several species of maple, elm, and walnut. Many species are not found or are rare west of the Amur basin.

4. Northeastern section with Okhotsk type of flora, Ayan fir spruce, and moss swamps.

5. Northern section of poor vegetation.

TABLE III—CROPS IN POUNDS FROM 2.69 ACRES (1911)

| PROVINCES | SUMMER WHEAT | SUMMER RYE | BARLEY | OATS | BUCKWHEAT | PEAS | POTATOES |
|---|---|---|---|---|---|---|---|
| Kiev . . . . | 1,376 | 1,312 | 2,432 | 2,944 | 1,984 | 2,880 | 17,920 |
| Transbaikal . | 992 | 1,248 | 1,024 | 1,120 | 480 | 800 | 13,920 |
| Amur . . . . | 2,048 | 1,696 | 1,952 | 2,240 | 1,280 | 1,920 | 16,672 |

In general there is much swampy soil. Grasses flourish in great variety but are not of great value for cattle.

Analogous to the diversity of plants is the diversity of the animal life. There is a mingling of forms; such northern species as the reindeer with such southern species as the tiger, western species as the hedgehog with eastern species as the raccoon.

## THE USSURI REGION

The Ussuri region constitutes the southern part of the Maritime Province, and its area is estimated at about 200,000 square miles. It is named from the River Ussuri, the course of which for the last 300 miles forms the boundary between the region and Manchuria. The only important depression is around Lake Khanka. The Sikhota-Alin range enters from the south running south-southwest to north-northeast along the coast of the Japan Sea and filling the entire region with its ramifications. It is not a single massive range as appears on most maps but a series of parallel chains. The general summit level is 2,000 to 3,000 feet; the greatest heights, with individual peaks attaining over 5,000 feet, are found in the south and center; approaching the Amur the mountains become lower and more rounded. The southern shore cuts across the grain of the country and is rich in inlets. North of St. Olga Bay the trend of the coast parallels the mountains and is broken only by Imperator Harbor.

The climate is cold for the latitude. The mean annual temperature is some 10° C. lower than for corresponding latitudes in western Europe, yet climatically the region is the best favored of the Russian Far East. The winter at Vladivostok lasts not more than five months. The Sikhota-Alin range is an important climatic divide, particularly in the south where the cloudy, foggy coast lands are sharply differentiated from the sunny interior. In 1914, from April to August, there were 48 foggy days at Vladivostok, and at some stations on the south coast this figure was doubled. Altogether four

climatic subregions can be recognized: (1) Southern Coastal region, (2) Southern Interior, (3) Central, (4) Northern. As illustrative of the difference between them we may note the mean annual temperature for 1914. For Vladivostok on the southern coast it was 5.5° C. (42° F.); for Chernigovka in the southern interior, 3.9° C. (39° F.); for Khabarovsk in the central district, 1.5° C. (34.7° F.); for Imperator Harbor in the north, −0.8° C. (30.5° F.). This range is largely due to differences in winter temperature. However, Imperator Harbor, washed by the cold waters of the Gulf of Tartary, has an abnormally low summer temperature.

Precipitation comes chiefly in the form of heavy summer showers not infrequently causing disastrous floods. There is, however, a rather critical variation in rainfall. Thus during the period 1899–1907 the range at Valdivostok was 257 millimeters (10 inches) to 853 millimeters (33.5 inches). In 1914, 904 millimeters (35.5 inches) was recorded. The amount of snowfall is likewise irregular in amount and distribution.

Assuredly there is a great economic future for Ussuri. It is well favored in respect of its coastal location and good harbors and interior waterways, in the presence of coal, iron, and zinc ores and building materials, and the proximity of important markets. In relation to the development of such resources the question of agriculture is of prime importance. What are the possibilities as regards climate? In the southern parts of the region the vegetative period approaches 200 days in length and even in the extreme north surpasses 100 days. The total of heat units (1915) at Vladivostok is 2,393; at Khabarovsk 2,554; at Imperator Harbor 1,612.

The greatest obstacles to agriculture are, in the north, the coldness of the coast in spring; in the south, the slow heating of the soil insufficiently protected with snow in winter and the fogs.

The agricultural products of the Ussuri region are characteristically varied. Fall and spring wheat, rye, oats, barley, buckwheat, and hemp are grown; also watermelons, melons, cucumbers, and all root crops. The numerous Chinese and Korean immigrants raise millet, beans, and corn, all of which do well; and in the last few years rice cultivation has been attempted and, contrary to all expectations, has succeeded. In regions where rice is grown in Europe, America, and most other parts of Asia the summer has not less than three months with a temperature above 22° C. (72° F.). We may, however, note the development of rice cultivation in Hokkaido where temperatures also are comparatively low. The warmest sections of Ussuri do not always have even one month with a temperature above 20° C. Rice was first planted in 1918, and two years later 6,725 acres were devoted to the crop. According to the estimates of A. D. Woeikof this acreage should be increased tenfold in 1921. Table IV gives some idea of the agricultural development of the region.

An index to the possibilities of agriculture is seen in the rich variety of the natural vegetation. Ussuri shares with the Amur region its character as a meeting place of northern and southern forms. The vegetation furthermore

TABLE IV—CROPS IN THE USSURI REGION (1911)

| CROP | AREA IN ACRES | CROPS IN ENGLISH POUNDS | NUMBER OF POUNDS PER 2.69 ACRES |
|---|---|---|---|
| Winter wheat . . . | 228,800 | 120,528,000 | 1,344 |
| Winter rye . . . . | 4,420 | 3,065,600 | 1,760 |
| Summer rye . . . | 23,140 | 10,582,400 | 1,184 |
| Barley . . . . . | 15,080 | 10,096,000 | 1,728 |
| Oats . . . . . | 208,520 | 138,432,000 | 1,728 |
| Buckwheat . . . . | 82,560 | 33,536,000 | 1,088 |
| Millet . . . . . | 17,420 | 20,505,600 | 3,072 |
| Peas . . . . . | 1,580 | 935,600 | 1,632 |
| Potatoes . . . . . | 27,520 | 138,304,000 | 14,144 |

attains great luxuriance. The forests are impenetrable with twining plants and vines; the grasses grow to great heights. Exposure and relation to the sea play an important part. Whereas northward-facing slopes are forested, southern slopes are apt to be forestless, for the alternation of warm days and freezing nights of February ruptures the plant tissues. The *taiga* on the southeastern slopes of the Sikhota-Alin presents an imposing appearance; but the summer dampness rots the heart of the timber, and it is useless for any purpose except fuel.

# COMPOSITE TEMPERATURE TYPES OF THE UNITED STATES*

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In a broad study of the essential characteristics of temperature over an extended area such as that of the United States, the conventional "typical" diagrams showing the annual march of temperature at certain selected stations are not wholly satisfactory. Such curves illustrate conditions which are often representative of small districts only. They not infrequently emphasize somewhat too strongly the local controls and peculiarities at individual places. They inevitably become associated with the names of the particular stations whose conditions they represent and may thus fail to bring clearly before the mind the larger and more general conditions which characterize broad areas.

## Composite Temperature Curves

In his own teaching of college students the writer has found it useful to employ, in addition to the temperature curves for individual stations, *composite* curves showing the annual march of temperature as illustrated by the mean monthly values summarized for a group of stations in the same general region or climatic province.

The following diagrams, here published for the first time, are used for purposes of instruction in the course on the climatology of the United States which has been given at Harvard during the past twenty years. Familiarity with these fundamental curves enables anyone to answer reasonable questions regarding the march of temperature in any part of the United States and also to name the climatic province in which an unknown station whose monthly temperatures are given is situated. These curves are constructed as follows. For each climatic province a representative series of stations is selected, ranging in number from ten to fifteen or twenty. In the majority of cases these are regular Weather Bureau stations, because they have the longest records and show conditions over the districts of densest population. Most of the places selected are fairly near sea level, but in the western mountain and plateau districts several of them are

* This is the eighth in a series of articles by the present writer on the climatology of the United States. The previous articles were: Climatic Subdivisions of the United States, *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 672–680; Rainfall Types of the United States, *Geogr. Rev.*, Vol. 4, 1917, pp. 131–144; Rainy Days and Rain Probability in the United States, Vol. 7, 1919, pp. 44–48; Frost in the United States, *Geogr. Rev.*, Vol. 7, 1919, pp. 339–344; Cloudiness in the United States, *Geogr. Rev.*, Vol. 9, 1920, pp. 347–356; New Monthly and Seasonal Rainfall Maps of the United States, *Geogr. Rev.*, Vol. 10, pp. 173–181; A New Series of Sunshine Maps of the United States, *Geogr. Rev.*, Vol. 10, pp. 339–341.

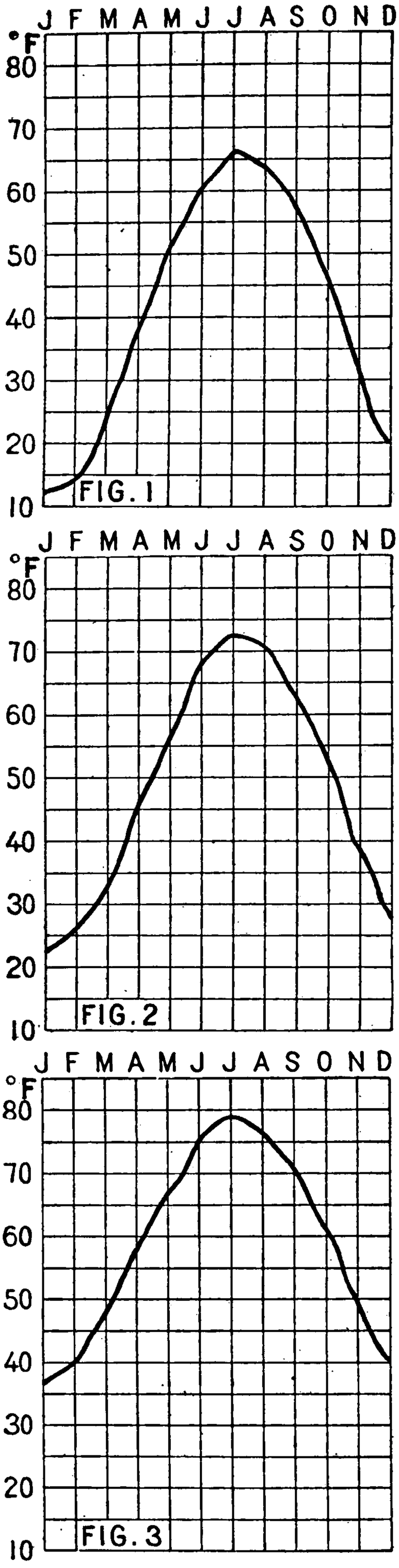
5,000 or more feet in elevation. In addition, the data for certain co-operative stations with long records are included, in order that the temperature in localities where there are no regular Weather Bureau stations may have representation. Altitudes above those of considerable human settlement are, however, not taken into account. More co-operative observers' records are used in the west than in the east. The data have not been reduced to a uniform basic period. Such reduction is unnecessary when observations for several stations, at various altitudes and with diverse topographic environment, are included in one general summary. The data employed are the latest and best available.

## Purpose of the Composite Curves

Composite curves of the kind here given are very satisfactory for the purpose for which they are intended to be and have been employed, i.e. to bring out the larger facts of temperature over considerable areas. The objection that these curves do not illustrate the actual conditions at any place and that they are therefore simply a "hodgepodge," is not valid when the specific purpose of the diagrams is considered. They are not intended to show the exact temperatures at any station. If it were desired to illustrate, e.g., the local conditions on mountains, in valleys, by the sea, around the Great Lakes, etc., an almost indefinite number of curves would be needed which, however interesting and important in themselves, would not be useful in any general study which must be completed within a limited time. Anyone who seeks such specific and exact information can find it in the very complete tabulations of data in *Bulletin W* and in other publications of the Weather Bureau. In *Bulletin W* the data for most of the 106 "sections" are grouped according to the natural topographic or other subdivisions (usually three or four) of each section. If a curve were drawn for each subdivision of all of the 106 sections, it can readily be seen that the number of such curves would run up to several hundred. The gain in simplicity which results from the use of a few composite curves such as those here given far more than offsets, in the opinion of the writer, the disadvantage that these curves do not represent any specific places. In the composites here given, representative data have been included for each of the more important subdivisions given in *Bulletin W*. This bulletin sets forth many facts of essential importance in any detailed study of temperature. The stations are grouped by counties as well as, in most cases, by climatic subdivisions; the altitudes are given, and a contour map for each section shows the exact location of each station and its general topographic surroundings.

## Classroom Use

In the use of these composite curves in the classroom, the logical method is first to familiarize the students with the curve for each large climatic province, as an illustration of the general conditions, and then to indicate,




FIGS. 1–12—Annual march of temperature by months for the climatic provinces of the United States.

FIG. 1—Eastern province, northern tier. Mean annual 40° ±; range 55° ±.

FIG. 2—Eastern province, central tier. Mean annual 50° —; range 50° —.

FIG. 3—Eastern province, southern tier. Mean annual 60° —; range 40° +.

verbally or by means of numerical data, how the conditions in the north and south, or on the mountains, or near the sea, differ from the composite. By following such a method the number of general temperature types remains relatively small and yet serves as the foundation upon which variations from the composite may be built up. The composite is the pattern. The departures from it are embroideries upon that pattern. It is important that all the curves be plotted on the same scale, and on co-ordinate paper slips of uniform size. By this method the differences in the monthly and annual temperatures themselves, and also the differences in the amounts of mean annual range, are clearly seen, and the larger effects of land and water are emphasized.

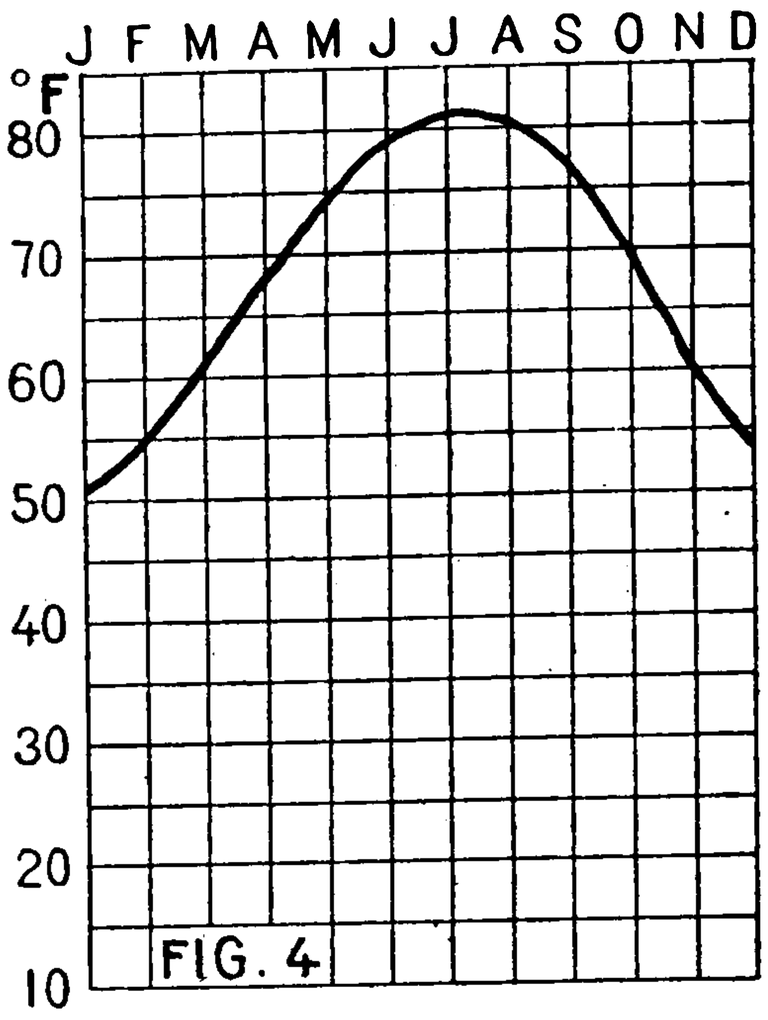
## THE EASTERN PROVINCE

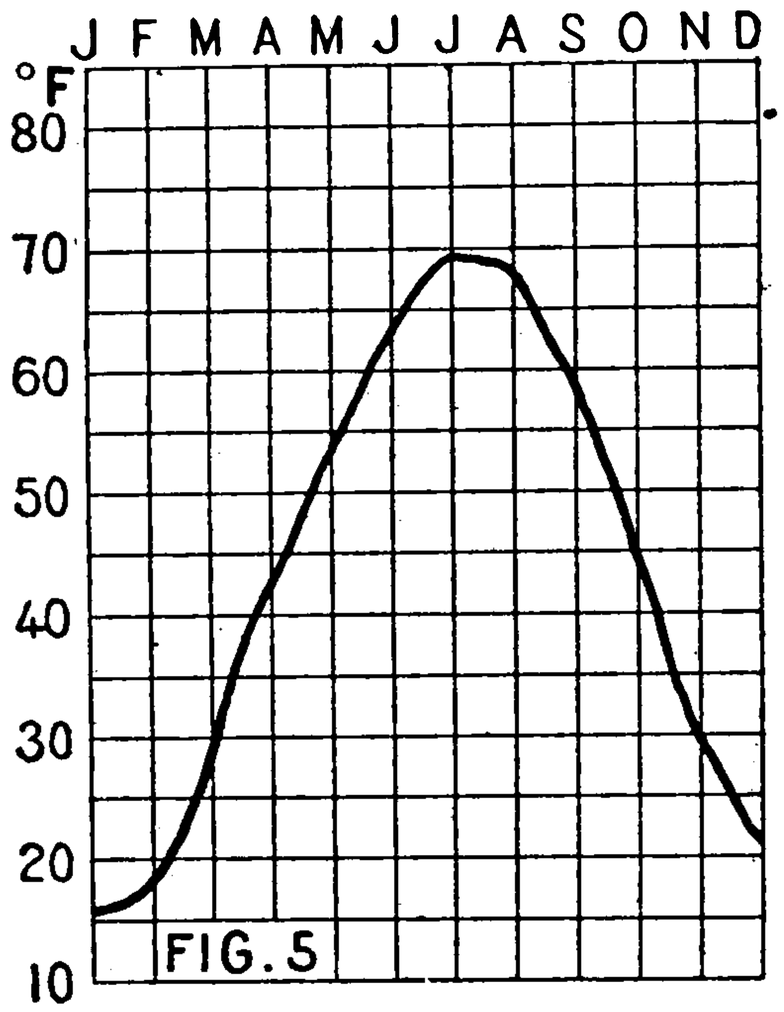
The Eastern climatic province extends from the Great Plains eastward to the Atlantic and southward to the section bordering on the Gulf of Mexico. Latitude, not altitude, is the fundamental control of temperature. Hence it is both logical and convenient, for the present purpose, to give three composite curves for this province, each curve representing an east-west belt of about 5° of latitude in width. The first of these (Fig. 1) is for the (a) *northern tier*, north of latitude 45° N., which extends from eastern North Dakota (including northeastern South Dakota) eastward across Minnesota and then across the northern portions of Wisconsin, Michigan, and New England. The second (Fig. 2) is for the (b) *central tier* of states, between latitudes 40° and 45°, lying between the eastern margin of the Great Plains and the Atlantic. The third (Fig. 3) is for the belt between latitude 40° on the north and the Gulf province on the south, and extends from the Great Plains to the Atlantic. This may be called the (c) *southern tier*.

Figures 1, 2, and 3 may best be considered together. The mean annual temperatures and the mean annual ranges are given in round numbers

below the curves. All three curves are distinctly continental in character. January and July are the coldest and warmest months respectively, and the annual ranges are large. From north to south the (composite) mean annual temperatures increase from about 40° to slightly below 60°, which is at the rate of about 10° for 5° of latitude, and the (composite) mean annual ranges decrease from about 55° to slightly over 40°. The increasing mildness of the winters and the increasing heat of the summers from north to south also appear distinctly in the differences in the position of the three curves on the co-ordinate base. From the fact that each of the three "tiers" covers a range of 5° (in the northern tier it is 5°−; in the southern tier it is 5°+) it follows that the northern stations will have colder winters and lower mean annual temperatures than the stations in more southern latitudes in the same tier. Thus the January means at the northernmost stations are in some cases as much as 10° (more or less) lower than those shown in the curves, and the southernmost January means are higher than those of the curves by the same amount or less.[1] Among the special characteristics which distinguish the temperature curves in different portions of the Eastern province, the following may be noted. It is a rather striking fact that the temperature conditions between the middle or even the western portions of the individual belts do not differ very greatly from those in the east, in spite of the considerable longitudinal extent of the belts. The reason is found in the fact that, chiefly under the control of the prevailing winds, the continental climate of the interior reaches the Atlantic Ocean. It is true, as has been pointed out, that the winters of the northernmost interior are colder than those farther south in the same belt; but if we take a belt of country like that between Chicago and Boston, for example, which the writer has for convenience described as the "New York Central belt," it is found that the mean annual and the mean monthly temperatures are essentially the same all along this belt. If a class of students be given the monthly means for Chicago, Cleveland, Albany, and Boston, e.g., without any indication of the names or the location of these four stations, it will, at any rate in the earlier stages of such a study, be found difficult if not impossible for the individual members of the class to determine whether the particular station in question is in New England or in New York or as far west as Chicago. Increasing familiarity with temperatures will, however, soon lead a class to distinguish between the somewhat colder winters of the farther western stations and the slightly milder winters on the Atlantic coast. Another special modification of the composite curves shown in Figures 1 and 2 appears around the Great Lakes, where "marine" influences at certain stations result in somewhat tempered winters and in a retarded minimum, February being either slightly colder than January or the two months having nearly the same mean temperature. A third modification, of a more local type, is seen in the cooling influence of the Atlantic Ocean

[1] "Northernmost" and "southernmost" refer to the most northern and most southern of the group of stations selected to make up the composite curve.



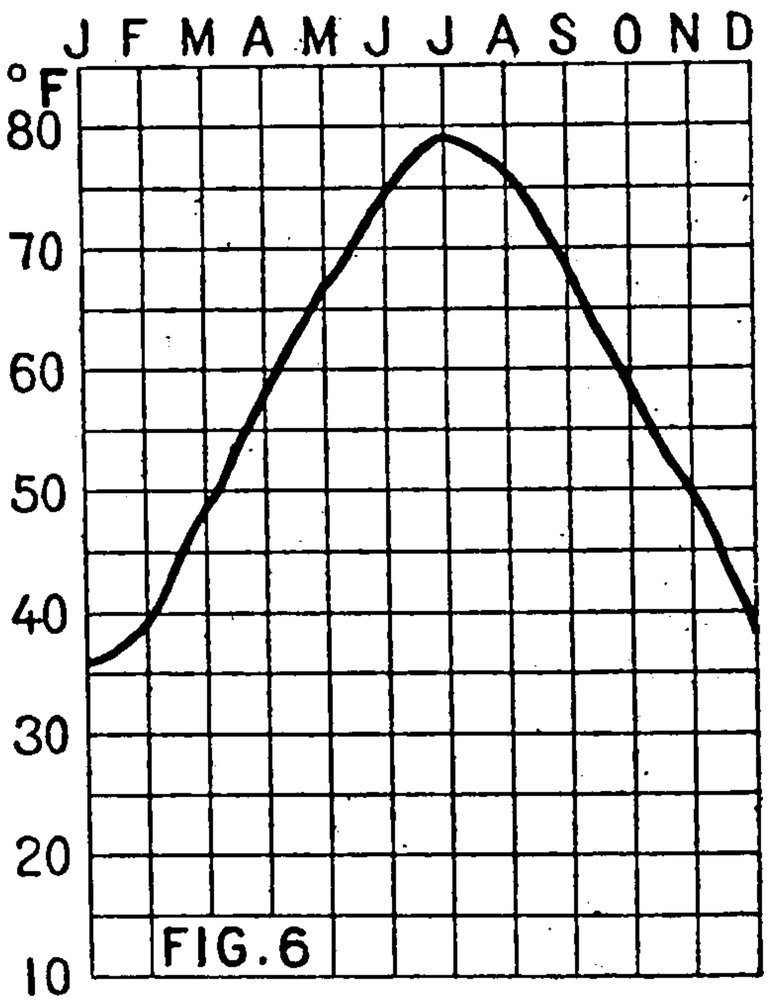




FIG. 4—Gulf province. Mean annual 70° −; range 30° ±.

FIG. 5—Northern Plains province. Mean annual 45° −; range 55° −.

FIG. 6—Southern Plains province. Mean annual 55°–60°; range 40° +.

at certain coast stations during midsummer. The coast of Maine is especially favored in this respect. Again, the modifying influence of altitude may be seen in the annual march of temperature at many stations scattered throughout the Appalachian area, from New England southward.

## THE GULF PROVINCE

Figure 4, which gives the composite curve for the districts bordering on the Gulf of Mexico and on the adjacent portion of the Atlantic (Gulf province), should be taken as part of the sequence already discussed in the preceding paragraphs.

The Gulf province is, obviously, only a fourth—the southernmost—tier of the Eastern province taken as a whole. From north to south the mean annual temperatures of these four belts are seen to increase about 10° from one tier to the next. The Gulf province thus has a composite mean annual of slightly below 70°. Its range is also about 10° less than that shown in Figure 3. The increasing mildness of the southern winters (individual January means are slightly over or under 50°) and the somewhat higher summer temperatures (July and August means are usually within a degree or so of 80°) are characteristic features. It will also be noted that August differs less from July than is the case in the preceding composites. The prevalence of on-shore winds along the southern coast during the summer months, together with the resulting partial marine control, doubtless explains this condition.

## THE PLAINS PROVINCE

The climate of the Great Plains differs from that of the eastern United States in rainfall rather than in temperature. The temperatures are here illustrated by two composite curves, one for the Northern and one for the Southern Plains. The line of division between the two roughly follows latitude 40°. Figure 5 shows the conditions based upon the data for a number

of stations in Montana, eastern Wyoming, and the western portions of the two Dakotas and of Nebraska.

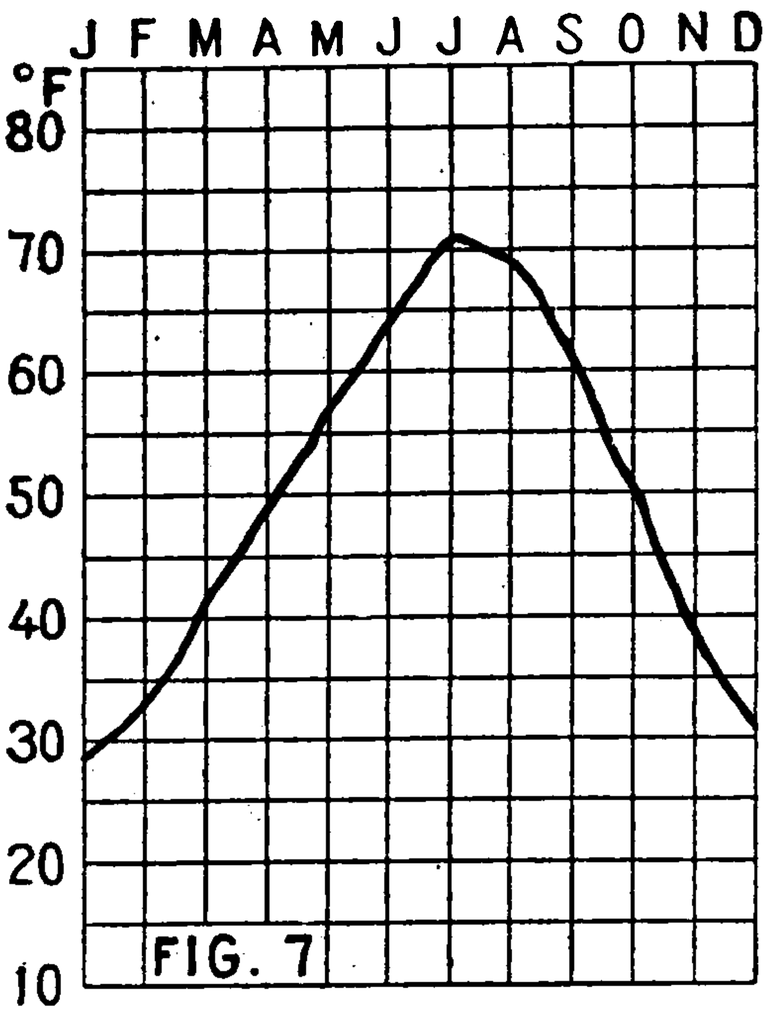
Figure 5 is very similar to Figure 1 but has slightly warmer summers, the composite mean annual range, expressed in round numbers, being about the same. At the Northern Plains stations, however, e.g. in North Dakota, the ranges are larger (over 60°) and the January means are 10° or so lower than those of the composite. At other stations, especially those farther south, the midwinter means are 5° or so above the composite means. There is, also, a variation of 5°–10° in the mean annual temperatures, according to the location of the individual stations. The rapid rise of temperature in spring, the fairly close similarity of the July and August means, and the rapid fall after the heat of the summer is over are noticeable. The warm summers of this great interior region of cold winters are an important climatic asset in relation to crop growth.

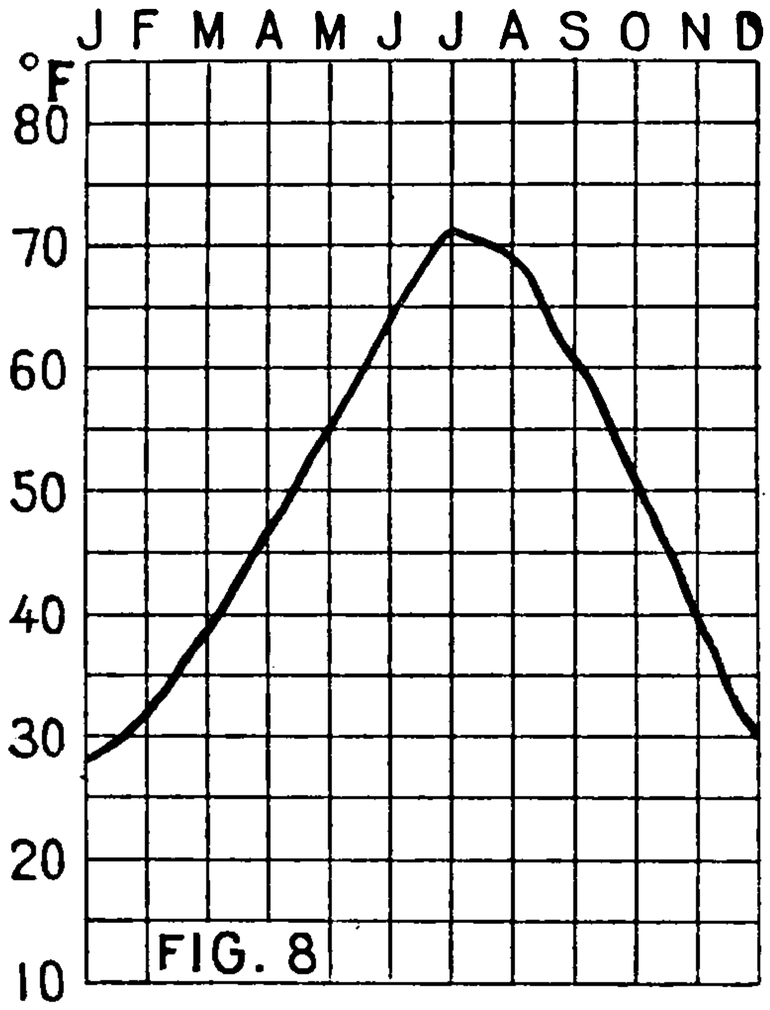
The Southern Plains (Fig. 6) have higher mean annual temperatures (55°–60° as against 45°–), smaller ranges (40°+ as against 55°–), much milder winters (warmer by about 15°–20° on the average in January), and somewhat warmer summers (July mean about 10° higher) than the Northern Plains. Comparing Figure 6 with Figure 4 (Gulf) it is seen that the latter has warmer winters, slightly warmer summers, and a smaller mean annual range. There is, however, naturally a very close correspondence between the Southern Plains province (Fig. 6) and the southern tier of the Eastern province (Fig. 3). The effect of latitude within the limits of the Southern Plains province is shown in the colder winters and lower mean annual temperatures at the northern stations. In the south, July means of 80° and slightly more occur.

## The Plateau Province

The curves for the northern and southern portions of the Plateau province are necessarily based upon data from stations differing greatly in their topographic environment and altitude. Individual localities therefore show considerable departures from the general means shown in these diagrams. Into the details of such variations the present discussion cannot attempt to go. If a very rough generalization is desired, it may be stated that there may be a variation of 5°, plus or minus, in the annual, January, and July means from those shown in the composite. A comparison of Figure 7 with Figure 5 (Northern Plains) shows that the latter district, east of the Rocky Mountain barrier, has colder winters, lower mean annuals, and larger ranges, while the summers are practically the same. The central tier of the Eastern province (Fig. 2) has a very similar curve to that of Figure 7, but the latter has milder winters and a smaller range.

The Southern Plateau province includes so great a range of latitude (nearly 10°) and so varied a topography that a single composite curve is of little significance. The more northern, and the higher, stations differ greatly from those on the low-lying deserts to the south in the summer "heat



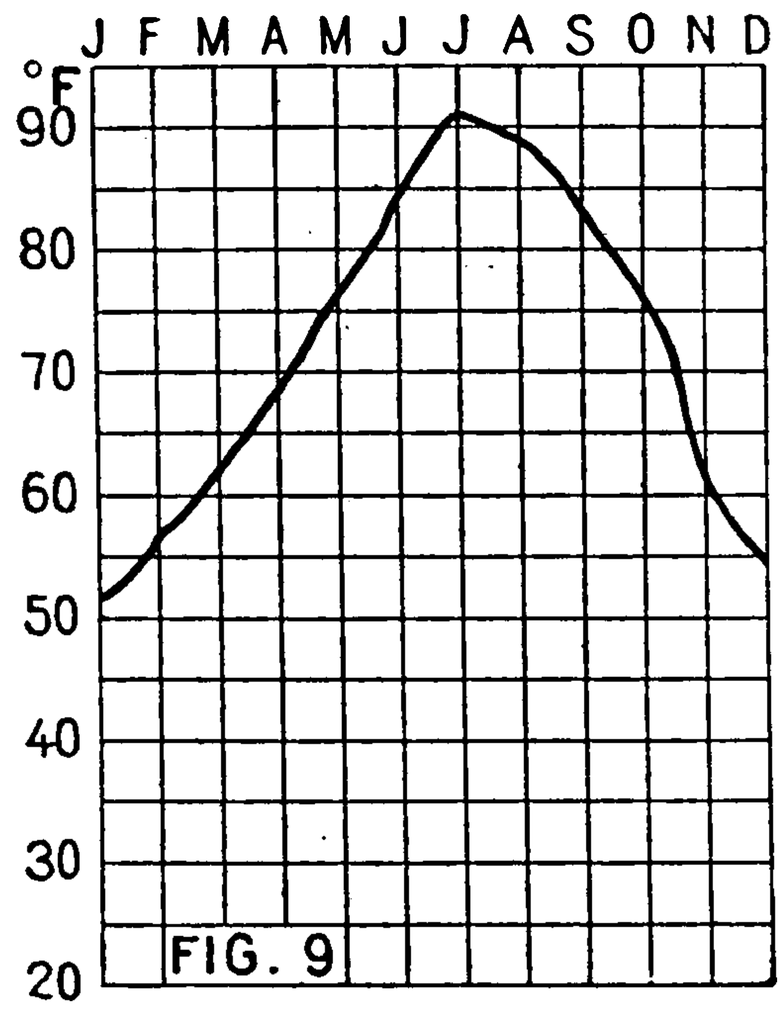




FIG. 7—Northern Plateau province. Mean annual 50° +; range 40° +.

FIG. 8—Southern Plateau province. Mean annual 50° ±; range 40° +.

FIG. 9—Southern Plateau (southern desert lowlands) province. Mean annual 70° +; range 40° —.

island" of this interior region. The data used in the construction of Figure 8 do not include the latter group of stations. It is at once seen that Figures 7 and 8 are practically identical, as is to be expected when Figure 8 includes only such stations as are in the northern portion of the Southern Plateau and at considerable altitudes. This general fact is worth bringing out. There are stations over the Plateau whose mean annual and mean monthly temperatures are very similar to those of stations in the central tier of the Eastern province, but the other climatic characteristics are quite different.

Stations in the low-lying and arid "heat island" of southern Arizona have quite a different temperature curve from the composite of Figure 8. Figure 9 is based on the data for certain well-known and representative stations in southern Arizona. (In this diagram, the scale is the same as in the other figures, but the position of the individual temperature readings on the co-ordinate paper has been changed in order to accommodate the higher summer means.) The winters on the southern "deserts" are decidedly milder and the summers hotter than is the case at the stations situated in the north and on the elevated plateaus. Thus, the mean annual temperatures at the southern localities are about 70°, and the July means reach and even slightly exceed 90°. There is little likelihood of confusing the temperatures in southern Arizona with those of the Gulf province (Fig. 4). The former has distinctly hotter summers, although the annual means are more or less the same.

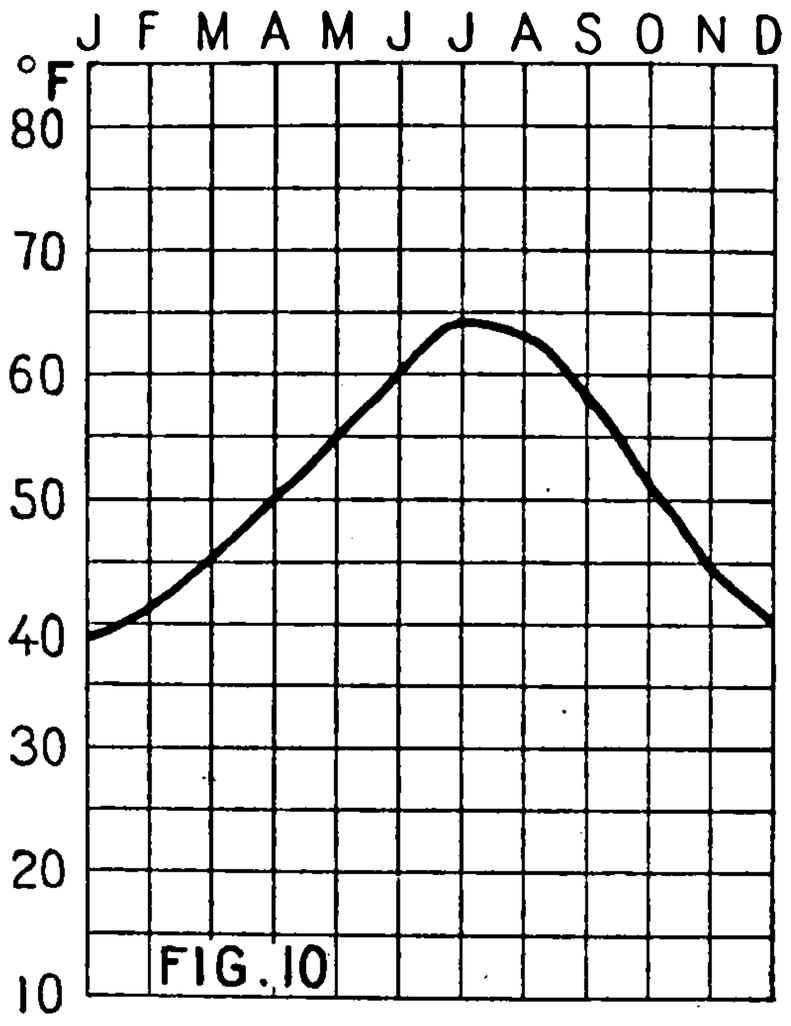
## THE PACIFIC PROVINCE

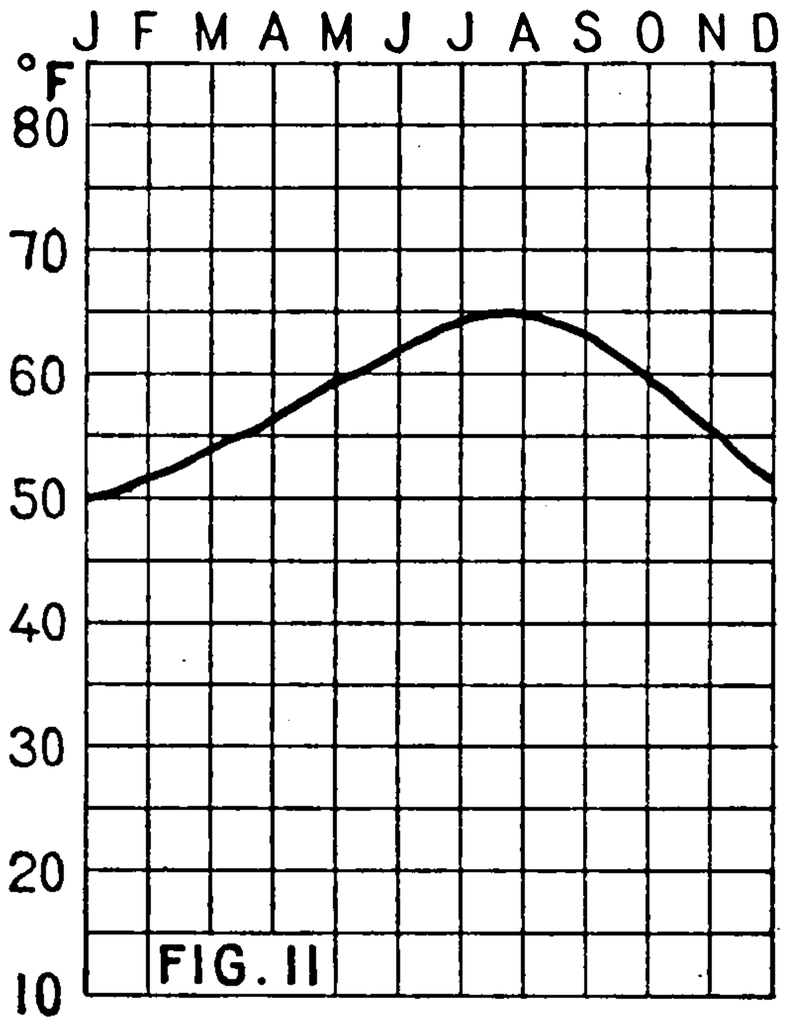
For the purpose of the present discussion the Pacific slope is conveniently subdivided into (1) Northern and (2) Southern Pacific provinces, and the latter into (a) coast and (b) interior valley. Many other local peculiarities of temperature distribution would appear if further subdivision were attempted, but the resulting

increase in the number of composite curves would offset the object which the writer has in mind.

The curve for the Northern Pacific province (Fig. 10) is based upon data for the coast, the Puget Sound region, and the interior valleys. In the north, the temperatures in the longitudinal valleys do not differ as much from those of the coast and of the Sound as do those of the Sacramento-San Joaquin valley, farther south, from the temperatures of the southern coast stations. Hence, it does not seem necessary, in a very general consideration such as that in hand, to make more than one curve for the Northern Pacific climatic province. The summers of the interior valleys, e. g. especially in southern portions of Oregon, are, however, naturally warmer by several degrees than those of stations like Seattle or Tacoma. The composite curve (Fig. 10) at once shows the marine influence on a windward coast. The winters are milder than those shown on any of the preceding curves except in the Gulf province (Fig. 4) and on the desert lowlands of southern Arizona (Fig. 9) but are not unlike those of the southern tier of the Eastern province (Fig. 3) and of the Southern Plains (Fig. 6) so far as the mean temperatures alone are concerned. The summers average cooler than those in any of the preceding curves, even than those of the northern tier of states in the Eastern province (Fig. 1). The range (about 25° only) clearly indicates the equability of the Pacific slope climates. The departures, at individual stations, of the annual and of the January means from those shown on the curve are too small to call for comment. The July means differ by roughly about +5° (in the southern interior valley of Oregon) to about −5° (on the extreme northwestern coast).

A composite of the Southern Pacific coast conditions is given in Figure 11. The stations included in the composite are nearly all south of San Francisco. Here are the most equable temperatures shown in any of the curves. The



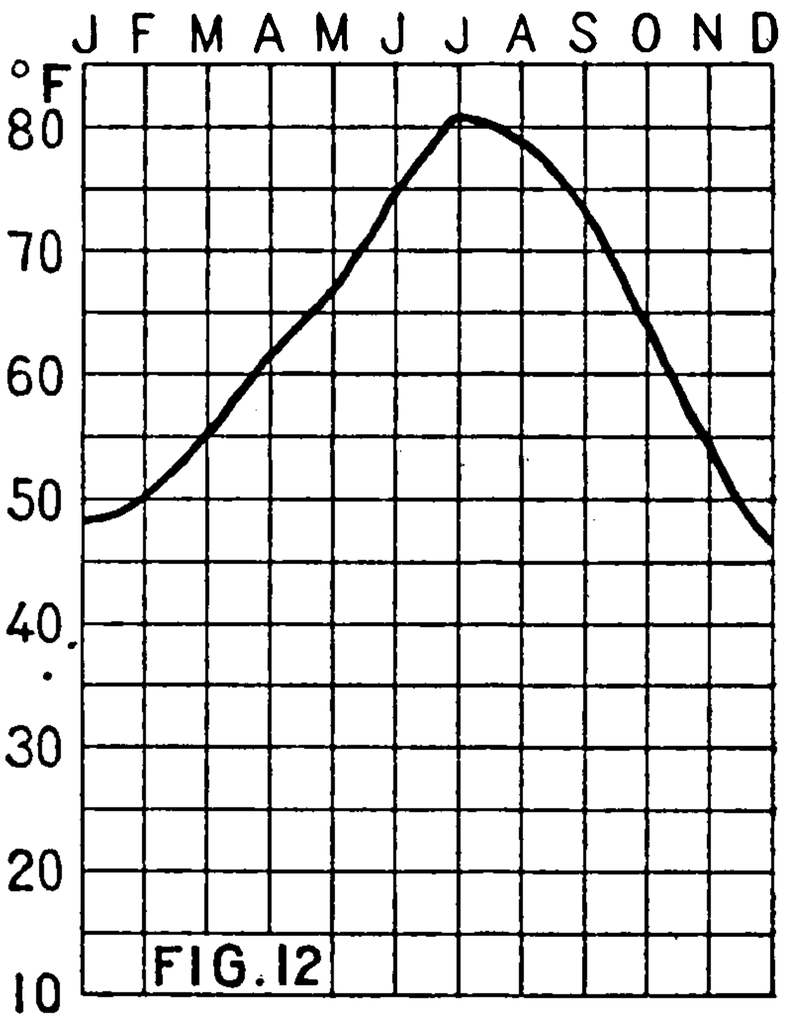




FIG. 10—Northern Pacific province. Mean annual 50°+; range 25°±.

FIG. 11—Southern Pacific (coast) province. Mean annual 55°–60°; range 15°.

FIG. 12—Southern Pacific (interior) province. Mean annual 60°–65°; range 35°±.

range is only about 15°, and the monthly means are all included between 50° and 65°. The retardation of the maximum into August is seen at several, although not at all, of the coast stations and is sufficiently frequent to appear on the composite. This is distinctly a marine characteristic. On the extreme northern coast of California the mean annual temperature is a few degrees lower than that of the composite curve, and on the extreme southern coast it is about the same amount above the general mean.

Figure 12 is based on the data from about a dozen stations in the Sacramento-San Joaquin valleys. It is not unlike that for the Gulf province (Fig. 4); but the mean annual temperature is higher, and the range is smaller in the latter. The July means in the California valley are higher than those seen in any other curve except that for the Gulf (Fig. 4) and that for the "heat island" (Fig. 9) but are only slightly above those of the southern tier of the Eastern province (Fig. 3). A natural comparison is that between the coast and the interior of California (Figs. 11 and 12). The continental controls in the latter are obvious. In the interior July is the warmest month, as contrasted with the (frequently) retarded maximum in August on the coast. The winters are milder on the coast, and the summers decidedly cooler. Hence the mean annual range in Figure 12 is decidedly greater (by about 20°) than that in Figure 11. The Northern Pacific coast winters (Fig. 10) are not quite as mild as those of the California valley, as is to be expected from the higher latitudes and other controls in the former case; but the summers of the Northern Pacific are decidedly cooler than those of the southern interior valleys. In spite of the great extent of the California valley in a north-south line, the temperatures are remarkably uniform throughout the district. The maximum departures from the composite means are somewhat less than + 5° at the southern stations in July. The foothills of the Sierra Nevada have their own type of temperature curve, their cooler summers as compared with those on the valley floor being a valuable asset in the popularity of that district for summer outings.

## Conclusion

In conclusion it may not be inappropriate for the writer to state what, in his experience, has proved to be an effective way to fix in the minds of students the essential facts regarding the temperatures of the United States. The stages in the successive laboratory exercises on this subject are as follows:

1. A study of the larger world relations of the sea-level temperatures over North America, based on the *Challenger* isothermal maps.
2. A critical comparative study of the advantages and disadvantages of sea-level and of actual temperature charts for the United States, based on various maps, e.g. those of the *Challenger* series, of Hann, of the Weather Bureau, of Herbertson, and of others.
3. The students are given, in three weekly exercises, the mean monthly

temperatures at certain selected stations whose location is unknown to them. These temperatures are plotted by each member of the class on co-ordinate paper slips similar to those used in the present discussion, and then each student indicates, as well as he can, the probable location of each station. The material used in working out these locations is that which is already familiar through the preceding exercises. When each student has located the stations to the best of his ability, the names and exact locations are given. The curves are then attached, by means of paper fasteners, to a large wall outline map of the United States, mounted on a soft-pine frame to which it is fastened by thumb tacks. The students put the curves onto the outline map themselves, and a stimulating rivalry is created by the teacher's selecting those curves which are most neatly and most accurately plotted for use on the wall map. When all the curves have been plotted and fastened to the outline map, the latter is uniformly covered, and the temperatures over all parts of the country can be further compared and memorized. The whole exercise never fails to interest the class, and while it is in progress there is always much animated discussion as to the probable location of the different stations whose monthly temperatures have been given.

4. The composite curves included in the present paper are used, at the end of the laboratory exercises just described, for the purpose of summarizing, in a very broad and general way, the essential facts of the distribution and characteristics of the temperatures in the different climatic provinces of the United States.

# THE EVOLUTION OF CLIMATE IN NORTH-WESTERN EUROPE: A REVIEW*

By Ellsworth Huntington

Yale University

During the last few years Mr. C. E. P. Brooks has published a number of important papers on changes of climate. In the article under review he gives an admirable summary of the main climatic pulsations from the height of the glacial period to the time of Christ. His climatic table, based on his article in the annual report of the Smithsonian Institution for 1917,[1] is as follows:

| Phase | Climate | Date |
|---|---|---|
| 1. Last Great Glaciation | Arctic | 30,000–18,000 B.C. |
| 2. Retreat of the Glaciers | Severe continental | 18,000–6000 B.C. |
| 3. Continental | Continental | 6000–4000 B.C. |
| 4. Maritime | Warm and moist | 4000–3000 B.C. |
| 5. Later Forest | Warm and dry | 3000–1800 B.C. |
| 6. Peat-Bog | Cooler and moister | 1800 B.C.–300 A.D. |
| 7. Recent | Becoming drier | 300 A.D.— |

This table needs amplification. Mr. Brooks bases his chronology largely on Gerard De Geer's measurements of the annual layers of clay in lake bottoms but makes much use of other evidence. According to Brooks, the last glacial epoch lasted roughly from 30,000 to 18,000 B.C.; but this includes a slight amelioration of climate followed by a readvance of the ice, known as the Buhl stage. During the time of maximum glaciation the British Isles stood twenty or thirty feet higher than now, and Scandinavia was "considerably" more elevated. The author believes that this caused a fall of 1° C. in the temperature of the British Isles and of 2° C. in Scandinavia. By an ingenious though not wholly convincing method of calculation, which is explained in previous publications, the author concludes that this increase of temperature aided by an increase in the area of the lands sufficed to start an ice sheet in Scandinavia. The ice area, though relatively small in extent, cooled the air and gave rise to an area of high barometric pressure. This in turn is supposed to have caused further expansion of the ice and thus to have led to full-fledged glaciation.

About 18,000 B.C. the retreat of the ice began in good earnest. Even though no evidence has yet been found, Brooks believes there must have

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*C. E. P. Brooks: The Evolution of Climate in North-West Europe, *Quart. Journ. Royal Meteorol. Soc.*, No. 199, Vol. 47, 1921, pp. 173–194, London.

[1] C. E. P. Brooks: The Correlation of the Quaternary Deposits of the British Isles with those of the Continent of Europe, *Ann. Rept. Smithsonian Instn.* for 1917, pp. 277–375.

been some change in the distribution of land and sea to account for the diminution of the ice. The ensuing millenniums formed the Magdalenian period in human history, the last stage of the Paleolithic, when man lived in caves and reindeer were abundant in central Europe.

## The Retreat of the Glaciers

At first the ice retreated very slowly, and there were periods when for scores of years the ice edge remained stationary or even readvanced. About 10,000 B.C. the edge of the ice lay along the southern coast of Sweden. During the next 2,000 years it withdrew more rapidly to about 59° N. Then came the Fennoscandian pause, or Gschnitz stage, when for about 200 years the ice edge remained in one position, forming a great moraine. Brooks suggests that this pause, about 8000 B.C., was due to the closing of the connection between the Atlantic Ocean and the Baltic Sea and the synchronous opening of a connection between the Baltic and the White Seas, whereby cold Arctic waters replaced the warmer Atlantic waters. He notes, however, that about 7500 B.C. the obliquity of the ecliptic was probably nearly 1° greater than at present. This he calculates to have caused the climate of Germany and Sweden to be 1° F. colder than at present in winter and 1° F. warmer in summer.

## The Continental Phase

The next climatic stage was marked by a rise of temperature till about 6000 B.C. During this period the ice at first retreated, presumably because the climate was ameliorating, although no cause of such amelioration is assigned. At length the ice lay far enough north to allow a connection between the Baltic and the Atlantic by way of Lakes Venern and Vettern in southern Sweden. This is supposed to have warmed the Baltic Sea and caused the climate to become distinctly milder. Next the land rose once more so that the Baltic was separated from the Atlantic and was converted into the Ancylus lake of fresh water. The southwestern Baltic region then stood 400 feet higher than now. The result was the Daun stage, about 5000 B.C., when the ice halted or perhaps readvanced a little, its front being then near Ragunda in about latitude 63°. Why such an elevation did not cause renewed glaciation, instead of merely the slight Daun pause, Brooks does not explain, although his calculations as to the effect of a slight elevation of the land during the main period of glaciation from 30,000 to 18,000 B.C. would seem to demand a marked readvance.

After 5000 B.C. there ensued a period when the climate, although still distinctly continental, was relatively mild. The winters, to be sure, were still cold, but the summers were increasingly warm. In Sweden, for example, the types of vegetation indicate that the summer temperature was 7° F. higher than now. Storms were comparatively rare except on the outer fringe of the British Isles. There they were sufficiently abundant so that in the

northwestern part of the islands they gave rise to the first Peat-Bog period, during which swamps replaced forests of birch and pine. Southern and eastern England, however, probably had a dry continental climate. Even in northwestern Norway storms were rare, as is indicated by remains of forests on islands now barren because of the strong winds and fierce storms. Further east most parts of central and northern Europe were relatively dry. This was the Early Neolithic period when man advanced from the use of unpolished to polished stone implements.

### The Maritime Phase

Not far from 4000 B.C. the period of continental climate was replaced by a comparatively moist maritime climate. Brooks believes that this was because submergence opened the mouth of the Baltic and caused the fresh Ancylus lake to give place to the so-called Litorina sea. The temperature in Sweden averaged about 3° F. higher than at present, and in southwestern Norway 2°. More important than this was the small annual range of temperature, due to the fact that the summers were cool while the winters were mild. Because of the presence of a large body of water in the Baltic region, storms, as our author states, then crossed the British Isles and followed the Baltic depression, carrying the moisture far inland. In spite of the additional moisture thus available the snow line in southern Norway was higher than now.

At this point Brooks turns to other parts of the world. He states that not far from 4000 B.C. a submergence of the lands, rarely amounting to more than 25 feet, took place not only in the Baltic region but in Ireland, Iceland, Spitsbergen, and other parts of the Arctic Ocean, as well as in the White Sea, Greenland, and the eastern part of North America. Evidences of a mild climate are found in all those places. Similar evidence of a mild, warm climate is found in eastern Africa, eastern Australia, Tierra del Fuego, and Antarctica. The dates are not established with certainty, but they at least fall in the period immediately preceding the present epoch. In explanations of these conditions Brooks assumes a universal change of sea level. He suggests with some hesitation that this may have been due to one of O. Pettersson's periods of maximum "tide-generating force." According to Pettersson the varying positions of the moon, earth, and sun cause the tides to vary in cycles of about 9, 90, and 1,800 years, though the length of the periods is not constant. When tides are high there is great movement of ocean waters and hence a great mixture of the water in different latitudes. This is supposed to cause the amelioration of climate. The periods of maximum and minimum tide-generating force are as follows:

| | | | | |
|---|---|---|---|---|
| Maxima | 3500 B.C. | 2100 B.C. | 350 B.C. | 1434 A.D. |
| Minima | 2800 B.C. | 1200 B.C. | 530 A.D. | |

Brooks thinks that the big trees in California and the Norse sagas and Germanic myths indicate a rough agreement of climatic phenomena with

Pettersson's last three dates, while the mild climate of 4000 B.C. may really belong to 3500 B.C. He gives no evidence confirming Pettersson's view of the other three dates.

### The Later Forest Phase

To return to our sketch of climatic pulsations, by 3000 B.C., that is toward the close of the Neolithic period, further elevation had taken place over the central latitudes of western Europe. Southern Britain, which had remained constantly above its present level ever since 30,000 B.C., was 90 feet higher than now. Ireland was somewhat enlarged by elevation, the Strait of Dover was almost closed, and parts of the North Sea were land. To these conditions Brooks ascribes the prevalence of a dry continental climate. The storms shifted northward once more, the winds were mild, as seems to be proved by remains of trees in exposed places, and forests replaced fields of peat and heath in Britain and Germany. The summers were perhaps warmer than now, but the winters were severe. The relatively dry climate prevailed as far west as Ireland. For example, in Drumkelin Bog in Donegal County a corded oak road and a two-story log cabin appear to belong to this time. Fourteen feet of bog lie below the floor and 26 above. This period, perhaps 3000–2000 B.C., was the legendary heroic age of Ireland when "the vigour of the Irish reached a level never since attained." This, as Brooks points out, may have been a result of the relatively dry climate, for today the extreme moisture of Ireland seems to be a distinct handicap. In Scandinavia civilization, or at least the stage of relative progress, was also high at this time.

### The Peat-Bog Phase

By 1600 B.C. the land had been submerged to its present level in the British Isles and the southern Baltic region, while northern Scandinavia still stood lower than now. The climate of Britain and Germany was so humid that there was an extensive formation of peat even on high ground not before covered. This moist stage seems to have lasted almost to the time of Christ and may have been the reason why the Romans describe Britain as peculiarly wet and damp. At this point Brooks again departs from northwestern Europe to a wider field:

> It is possible that we have to attribute this damp period in North-West Europe to some more general cause, for Ellsworth Huntington's curves of tree-growth in California and climate in Western Asia both show moister conditions from about 1000 B.C. to A.D. 200, and the same author believes that the Mediterranean lands had a heavier rainfall about 500 B.C. to A.D. 200. It seems that the phase was marked by a general increase of the storminess of the temperate regions of the northern hemisphere at least, with a maximum between Ireland and North Germany, indicating probably that the Baltic again became the favourite track of depressions from the Atlantic.

### Postglacial Changes in North America

Mr. Brooks ends his paper with a brief résumé of postglacial changes in North America; but, as the means of dating events are unreliable, the degree

of synchronism with Europe is not clear. He sums up his conclusions as follows:

> On the whole it appears that though there is a general similarity in the climatic history of the two sides of the North Atlantic, the changes are not really contemporaneous, and such relationship as appears is due mainly to the natural similarity in the geographical history of two regions both recovering from an Ice Age, and only very partially to world-wide pulsations of climate. Additional evidence on this head will be available when Baron de Geer publishes the results of his recent investigations of the seasonal glacial clays of North America, especially if, as he hopes, he is able to correlate the banding of these clays with the growth-rings of the big trees.
>
> When we turn to the north-west of North America, this is brought out very markedly. For in Yukon and Alaska the Ice Age was a very mild affair compared with its severity in eastern America and Scandinavia. As the land had not a heavy ice-load to recover from, there were no complicated geographical changes. Also, there were no fluctuations of climate, but simply a gradual passage to present conditions. The latter circumstance especially seems to show that the emphasis laid on geographical rather than astronomical factors of *great* climatic changes is not misplaced.

Mr. Brooks's painstaking discussion of postglacial climatic changes is of great value because of the large body of material which he has so carefully wrought together. His strong belief in the importance of changes in the level of the lands deserves serious consideration. It is difficult, however, to accept his final conclusion that such changes are the main factors in *great* climatic changes. It is almost impossible, for example, to believe that movements of the land could produce almost the same series of climatic changes in Europe, Central Asia, the western and eastern parts of North America, and the southern hemisphere. Yet that is what appears to have happened during and since the glacial period. Again, there is no evidence whatever that movements of the land have anything to do with the historic cycles of climate or with the cycles of weather in our own day, which seem to be the same as climatic cycles on a small scale. Also, as Dr. G. C. Simpson points out in the discussion of Mr. Brooks's paper before the Royal Meteorological Society, there appears "no solution along these lines of the problem connected with rich vegetation in both polar circles and the ice-age which produced the ice-sheet at sea-level in Northern India." We may well believe that Mr. Brooks is right in holding that changes in the relative level and relative area of land and sea have had important local effects. His appeal to astronomical causes is not really a sign of weakness in his own theory, as was suggested in the discussion. It is merely a sign that so complicated a natural phenomenon as climatic changes cannot be explained by any one theory. While changes in the level of the lands may not be the main cause, they are certainly a contributory cause which cannot be neglected.

# GEOGRAPHICAL RECORD

## AMERICAN GEOGRAPHICAL SOCIETY

**Meetings of November and Elections to Fellowship.** The first regular monthly meeting of the American Geographical Society for the season of 1921-1922 was held on November 22 at the Engineering Societies' Building, 29 West Thirty-ninth Street. President Greenough presided. There were presented with the approval of the Council the names of 384 candidates who were duly elected as Fellows of the Society. Thereupon the Society was addressed by Professor Henry E. Crampton on "Guam, Siam, and Java—Three Representative Countries of the Far East." In this well-illustrated lecture Professor Crampton described his sixth journey in the Pacific Islands, the latest of eleven journeys in the tropics.

A special illustrated lecture on "Present-day China" by Mr. J. O. P. Bland was given on November 10 at the Society's Building, Broadway at 156th Street. Mr. Bland was for many years associated with the Chinese government and is well known as the author of several standard works on China. He made an earnest plea for the support of China that the country's unique civilization might continue to develop along native lines.

**Distribution of Title Page, Contents, and Index of Volume 11 of the "Geographical Review."** The title page, table of contents, and index for Volume 11 of the *Geographical Review* (1921), which is issued separately, is ready for distribution. Copies are sent to all institutions exchanging publications with the Society and to individuals who request that their names be put on a list for this purpose.

## NORTH AMERICA

**Canada's Boundaries.** "The Unguarded Boundary," an address by Ambassador John W. Davis as President of the Birmingham and Midland Institute of Great Britain for 1920, recalls the satisfactory condition of affairs respecting the boundary between the United States and Canada. The amicable settlement of this international boundary may be regarded as a great achievement in view of the length of line—5,400 miles—and the variety of natural conditions encountered and the variety of conflicting claims invited thereby. These conditions are graphically sketched by Ambassador Davis in recounting the romance of the early days of the frontier and the history of the subsequent boundary negotiations beginning with the treaty of 1783 and terminating with the decision of the Alaskan tribunal in 1903.

The work of surveying, defining, and marking the boundary is nearing an end. Surveying of the southern boundary is practically completed, and the maps are being made upon which the commissioners lay down the line in its final position. In certain sections, particularly from the Lake of the Woods to Lake Superior, along Hall's Stream (a headwater stream of the Connecticut River), St. Francis River, and the line from the source of the St. Croix River to Passamaquoddy Bay, the final determination remains to be made, but it is not anticipated that any serious differences will arise. As regards the boundary between Alaska and Canada the section along the 141st meridian, that is from the Arctic Ocean to Mt. St. Elias, has been demarcated (Report and Atlas published in 1918); and the "natural" boundary from Mt. St. Elias to Cape Muzon, the southern extremity, has been laid down and agreed upon, and reports and maps are in preparation.

The Dominion, however, has a boundary question on its hands in the dispute with Newfoundland over Labrador. Since 1763, with a lapse between 1774 and 1809, Newfoundland has had jurisdiction over a portion of the "coast" of Labrador (James White: Boundary Disputes and Treaties, Toronto, 1914). The wording of the Labrador Act of 1825, which was supposed to be definitive, is obscure. All that the Act established beyond question was the short stretch of boundary due north from Blanc Sablon to the 52nd parallel. Northward, indeed, there was no immediate practical need for settlement; interest in the region was confined to the seaboard frequented by Newfoundland fishermen. Recently, however, attention has been called to the lumbering possibilities of the interior, which have been

proved to be considerable, and to the possibilities of mineral resources which remain to be investigated. Development is precluded until land titles are assured, and this awaits settlement of the boundary issue. Quebec, which since 1912 has included all the remaining portion of the peninsula, claims the limitation of Newfoundland to a narrow coastal strip. Newfoundland makes claim to a considerable hinterland, including the timberlands of the Hamilton River basin. A commission is now at work on the problem (*Current History*, New York Times, February, 1921, pp. 264–265). It is suggested that an ultimate result of the case will be inclusion of Newfoundland in the Dominion of Canada.

## SOUTH AMERICA

**Memorial to James Orton on Lake Titicaca.** On the shores of Lake Titicaca on September 25 of last year there was unveiled a memorial to James Orton, one of the group of American explorers, who in the latter half of the last century made material contribution to our knowledge of the upper Amazon basin (*West Coast Leader*, Sept. 17 and Oct. 1, 1921). On his first expedition (1867) Professor Orton crossed the Ecuadorean Andes and descended the Napo. One of the results was "The Andes and the Amazon" (1870), a volume that went into three editions. The third edition also included notes on a second journey in 1873 up the Amazon to Yurimáguas on the Huallaga and thence over the Andes. In 1876 Professor Orton organized a third expedition with the object of exploring the Beni. On this he was accompanied by Ivon Heath, brother of Edwin Heath who a few years later made a successful exploration of that river. The party proceeded via Cochabamba and Trinidad to within 25 miles of the confluence of the Beni, where in consequence of a mutiny by the Indians of the party their plans were abandoned. They turned back up the Mamoré to Exaltación and thence across the pampas to Reyes and over the Andes by Apolobamba, an exhausting journey of 600 miles. To the hardships encountered Professor Orton succumbed while crossing Lake Titicaca. He was buried on Esteves Island, a rocky islet in the Bay of Puno. It is here that the memorial, a monument of New Hampshire granite in the form of the ancient Inca burial towers, has been erected. It was contributed by the Alumnæ Association of Vassar College, where Orton was professor of natural history at the time of his death. Presentation was made to the Peruvian Government by a delegation from the Association at a ceremony attended by members of the diplomatic corps and representatives of scientific and educational institutions.

## EUROPE

**The Economic Geography of Northern Sweden.** Northern Sweden (Norrland) has an area of some 100,000 square miles—60 per cent that of Sweden as a whole—and a population a little over 1,000;000, that is 18 per cent of the total population of the country. Small as this figure is it represents a great relative gain on that of a half-century ago, a gain furnished in part by a relatively great natural increase and in part by immigration from more southerly regions. This movement of the population follows on industrialization of the region, a process described in detailed and well-illustrated fashion by H. W. Ahlmann in a recent number of *Geografiska Annaler* (Vol. 3, Parts 1 and 2, 1921, pp. 96–162). Figures showing the occupational distribution of the population, while only approximate, are significant of the change. For the southernmost district of Norrland (Gävleborg) percentages of population engaged in farming, forestry, and allied occupations; in mining and manufacturing; and in trade communications respectively were 79, 11, and 2 in the year 1840; while they were 44, 38, and 13 in 1910. For the northernmost district (Norrbotten) the figures are 89, 4, and 1 for 1840; and 60, 25, and 10 for 1910. (Compare the notes and see the maps on regional divisions of Norway in *Geogr. Rev.*, January, 1921, pp. 143–145.)

As regards economic development Norrland suffers under the handicap of its far-northern situation, involving relative inaccessibility and severe climate, and its unfavorable surface, presenting vast expanses of bare Archean rock. Its assets lie in its forests, its waterways, water-power resources, and iron-ore deposits. The forests are the greatest asset. Economic transformation of Norrland began with transformation of forest economy based on the introduction of steam sawmills in the sixties of the nineteenth century. Development of the lumber industries strengthened the already pronounced discrepancies of regional population distribution. The sawmills were placed at the river mouths, or rather on the bays beyond the river deltas or on the inner shores of the fringing islands, provided with

sheltered fairways, good harbors, and sufficient space. Lumber is easily floated down from the interior to the coast. It is estimated that there is 1 kilometer of waterway suitable for floating logs to 9.5 square kilometers of surface and that the average maximum distance for the hauling of logs is no more than 7 or 8 kilometers. Woodworking industries are thus concentrated on the seaboard, save charcoal burning and the associated production of tar and turpentine, which remain in the forests. The scanty population of the great Archean plateau is reflected in the bare one per cent of its surface under cultivation. The eastern plain has 66 per cent of the population and 80 per cent of the town dwellers. Round the sawmills of the Sundsvall district there are 600 to 800 people per square kilometer (1,550 to 2,000 per square mile). Sundsvall itself is a center of 16,861. To the new settlements on the outer border of the coastal plain the old towns, usually situated some distance up the river. act as administrative and trade centers.

The growth of population dependent on the present phase of forestry exploitation terminated a decade or so ago. Since 1900 the movement of migration has been reversed, many thousands of people leaving Norrland. The population of the sawmill districts of Sundsvall has declined, and so has that of several rural districts adjacent to industrial areas. In spite of the addition of the pulp industry in the last decade (it was earlier in southern Sweden), production and export of lumber has increased little since 1900. From large areas the first forest crop has been taken. Modern sawmills, furthermore, need fewer hands in proportion to the output. Future of the lumbering industries is dependent largely on the adoption of a rational system of forestry management. Attention should be paid to development of the charcoal industry, of importance in relation to the iron industry of the north: it would further tend to an increased population in the forest areas.

Future economic expansion is also dependent on utilization of the hydro-electric resources of the region. Out of a total of 5 to 6 million horse power for all Sweden, upper Norrland has 2,400,000 horse power, and lower Norrland with Dalarne 2,500,000. Of the latter 15 per cent has been developed, only 7 per cent of the former. There is hope of establishing such electrometallurgical and electrochemical industries as have been established in the French Alps. In the extreme north of Norrland, in latitude 67°–68° N., are the valuable iron-ore deposits of Kiruna and Gällivara which up to the present time have been exported in the raw state.

Economic expansion will be further conditioned by improvement in communications. Raw materials collected in the interior and brought down the northwest-southeast-trending valleys are concentrated at the river mouths to be sent by sea, the great highway of Norrland trade both import and export. Of the export trade (chiefly iron ore and lumber and other forest products) about 33 per cent is across the Norwegian border, less than 2 per cent by rail southwards, the rest by sea. Of the import trade (chiefly wheat and coal) about 3 per cent is across the Norwegian border, 7 per cent by rail from the south, the rest by sea. Yet navigation is suspended for several months during the winter. It should be made continuous or at least extended by the use of ice breakers, as is done on the eastern shores of the Bothnian Gulf, at Hangö, for instance.

With the exception of the ore railroads of the north, the railroads of Norrland have been of comparatively slight importance. There is, however, now under projection the Inland Railway which will connect the far north with an ice-free port in Swedish territory (in Göteborg). It will traverse the eastern border of the lake zone. Electrification of the railroads is also proposed.

It is hardly likely that there will be any great agricultural expansion as an independent movement, though completion of the Inland Railway will encourage farming in the richer lands of the interior, the "Silurian" zone of limestone soils and the lake zones with their alluvial patches. Agricultural expansion, however, is likely to accompany industrial expansion. At present agriculture is concentrated about the mouths and lower parts of the rivers, but even in the coast region only one-fifth of the land estimated cultivable is in use.

**Racial Composition of the Population in Northern Norway.** A not uncommon misconception that northern Norway is populated mainly by Lapps and Finns has led the Norwegian Central Bureau of Statistics to issue a pamphlet setting forth the numbers and distribution of the racial elements in this region (Befolkningsforholdene i Nord-Norge med saerlighensyn til nasjonalitet, Christiania, 1920). A table showing population according to the census of 1910 is accompanied by a map on the scale of 1:1,000,000 showing population of communes and prefectures by circles of area proportional to population (1 square milli-

meter representing 10 persons). The circles are colored according to race—Norwegian, Lapp, Finn. The map, it may be noted, has been prepared by the Inspector of the reindeer pastures for the Ministry of Agriculture and, while exact representation is always difficult in a region of mixed population, is believed to be as accurate as possible.

The whole of northern Norway had a population of 280,785 in 1910, of whom 6.5 per cent were Lapps and 2.8 per cent Finns. In the northeasternmost prefecture, Finmark, Lapps formed 26.4 per cent and Finns 13.3 per cent of the population. Only in a few small districts, mainly inland, was there a Lapp majority. In the southwestern prefecture (Nordland) Lapps numbered 1.1 per cent and Finns less than .1 per cent. Norwegians, furthermore, are increasing both absolutely and relatively. There is a well-marked migration into the north from more southerly regions.

There is a similarly small proportion of Finns and Lapps in northernmost Sweden. Lapps in Norrland numbered 7,000 in 1910 and Finns 24,770 out of a population of over 1,000,000 (see note above). In both instances they form an altogether strange element in the occupation of the land. A number of the Lapps are nomadic, and their movements provoke the usual troubles that rise between settled and migratory peoples. The Lapp reindeer damage the hay of the Swedish farmer. More seriously, international disputes arise. The nomads are not respecters of boundaries; their pasture lands extend indifferently across the frontier. Some few years ago commissions were appointed to settle the international difficulties, and in 1920 a reindeer pasture convention was made between Sweden and Norway.

## AFRICA

**The Political Geography of Italian North Africa.** About a hundred years ago the founder of the Senussi confraternity, one of many that sprang to life within the Mohammedan world, withdrew from the Europeanized sections of the coast and established himself in an isolated and remote portion of the Sahara, the hinterland of Cyrenaica. Thence his power and that of his successors spread through a large section of the desert and even beyond its southern border. Established eventually in the oases of Kufara which became the center and capital of the Senussi realm, the Senussi leaders exercised a wide and profound influence. The trans-Saharan trade not only passed through the heart of their territory, it was fostered and welcomed. Free hospitality was offered any traveler for a period of three days. Moreover, the oases of Kufara are virtually self-supporting and are protected by a one-hundred-mile belt of sand dunes and by a still wider stretch of all but waterless desert. The geography of the region is admirably adapted to the support of one of the prime conditions of the founder that his people should keep away from the centers of civilization and unite various Bedouin tribes in one great religious organization.

If we have this picture before us and if we also appreciate the sinister reputation which the Senussi had among Europeans for a half century, we are prepared to understand the very extraordinary change of situation that has been brought about by Italy within the past few years. Sayed Idris, the head of the Senussi, has visited Rome; and he has made a treaty with Italy! He has been given the hereditary title of Emir and is the acknowledged independent ruler *on behalf of Italy* over the oases of Kufara, Jaghabub, Jalo, Aujila, and Jedabiya.

This vital change of policy on the part of the Senussi may affect the whole Mohammedan world, for Libya has been recognized for the past half century and more, as a critical area in the struggle of Moslem against Christian, with the Moslem situated in the desert whence war was waged against an European population on the coast. The struggle was long continued though fitful until 1911, when, in the Turco-Italian War, Italy pushed her frontier across the Mediterranean and established herself upon the northern coast of Africa; and thus the power of Rome once more claimed a long abandoned portion of the empire of the Cæsars. A war with the Senussi was inevitable and continued through the World War. The weakness of Senussi power was rather definitely revealed when Senussi troops attempted to invade Egypt. The British defeated the Senussi forces in February, 1917, at the oasis of Siwa, and since that time Italy's path has been easier. Finally, in November 1920, by the accord of Regima, the Italian government and the Senussi ratified the so-called Italo-British Agreement. This agreement was made between the British and Italian governments, on the one hand, and Sayed Idris as the head of the Senussi on the other.

By the terms of the agreement the Italian government will retain the coast towns and certain posts it now occupies a short distance inland, but it will create no new posts. The

Italian government also maintains courts and schools, pays monthly allowances to certain members of the Senussi in addition to supplying them with arms, ammunition, equipment, and food up to the amount required for four thousand men. The purpose of the last stipulation is to enable the Senussi to maintain public security in the interior of Cyrenaica. On their part the Senussi agree to maintain peace in the interior, to disarm the population, to form no new military posts, and to allow Italian delegates to enter the interior on Government business (*Journ. Central Asian Soc.*, Vol. 8, 1921, Part IV, pp. 177-178).

The development of these events affects to a marked degree the entire policy of Italy toward Mohammedans elsewhere. It is claimed that Italy's withdrawal from Valona in Albania after her prolonged efforts to maintain a naval base there in the negotiations of Paris, 1919–1920, was the chief basis of confidence on the part of the Senussi that Italy would treat fairly with them and with the rest of the Mohammedan world, for it was the Mohammedan population of Albania that particularly feared Italian encroachments upon

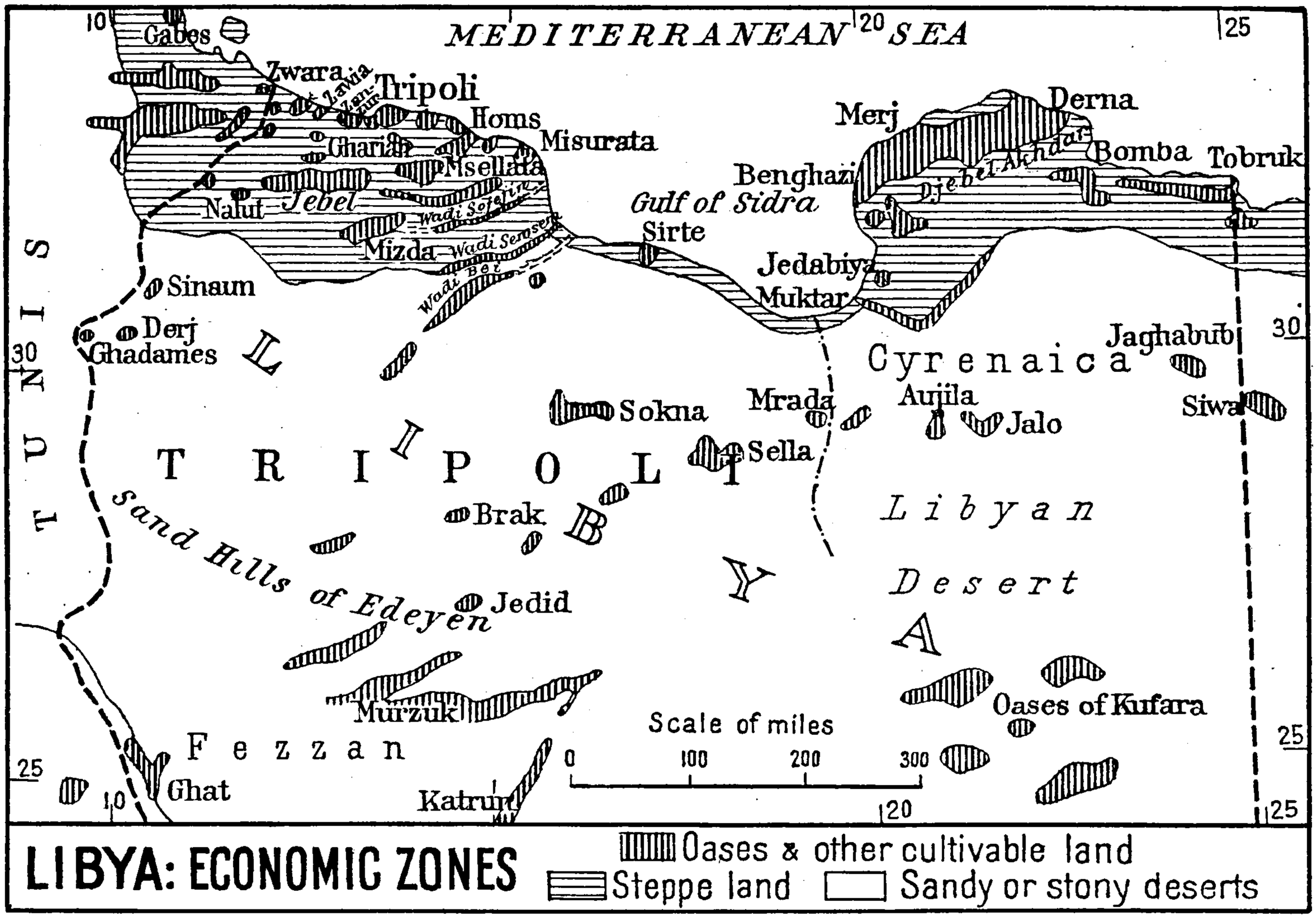


FIG. 1—Sketch map of Libya showing economic zones.

their territory. It will be remembered that by the secret Treaty of London, in 1915, Italy was to have a large section of Albania about Valona, and there was to be created out of the large block of central Albania an autonomous Moslem state under Italian protection. In framing this policy Italy, Great Britain, and France did not consult the Moslem population of Albania, and the announcement of the proposed action of these allies had aroused a certain resentment.

According to an elaborate report of a French mission to Tripoli, which, with Cyrenaica, as shown in Figure 1, forms the Libyan colony (Camille Fidel: Une mission en Tripolitaine, *Renseign. Colon.* (*Suppl. à l'Afrique Française*), 1921, No. 2, pp. 17-38; No. 3, pp. 47-58; No. 4, pp. 94-103). Italy has seized upon this occasion to ingratiate herself with the Mohammedans elsewhere, particularly in Anatolia. Her relations with the Nationalists of Turkey have been conducted in far better spirit than is the case of the French. It would be possible for Italy to take advantage of French and British difficulties with the Moslem and particularly the Arab world and make a common policy difficult. Germany's defeat has withdrawn her influence from the region, and this also opens the door for Italian aspirations.

In the report of Fidel alluded to above we have an admirable summary of the physical and economic conditions in Tripoli which confront Italian statesmen. There is an elaborate

table by provinces and types of population (No. 2, p. 20), and the totals are subdivided in the table so as to give also by territories the number of sedentary, semi-nomadic, and nomadic populations. The figures for the three classes named are, in round numbers, 356,000, 128,000, 84,000 respectively.

In passing from the coast toward the interior one finds four zones. The first is the narrow zone of the coast in which palm culture predominates but in which there are also cultivated olives, fruits, grains, and vegetables. The second zone is formed of high plateaus and is marked by deep valleys and steep-sided gorges which have only local sources of water. There are patches of forest, some development of the palm, and, outside the oases, stretches of territory suitable for cereal production and the growth of cultivated trees. These two zones have an extent of 50,000 to 60,000 square kilometers, or one tenth of the total surface of Tripoli; four-fifths of the population of the country; and almost the whole of the agricultural production and the production for export.

The third agricultural zone is constituted by scattered oases separated by great distances, such as Ghadames, Derj, Sinaun, Sella, and in valleys that descend from the mountains on the western border of the Gulf of Syrtes (Sidra). The author supplies figures for the extent of cultivation in the principal oases of this group.

The fourth agricultural zone includes the oases of Fezzan and Ghat, separated from the third by a broad stretch of practically useless desert except for minor oases.

In the cultivated lands the author emphasizes two quite different aspects. The first is characterized by irrigation, as in the oases, where the water table is at a slight distance beneath the surface. The other type is characterized by dryness, where agriculture is dependent entirely upon water that falls from the sky, and only exceptionally upon water supplied by torrents and available during the periods of rain. The oases of the coast are divided into small properties, and some are community lands under group control. The water is found at a depth of two to fifteen meters. European occupation has brought improvement in the method of pumping the water, electricity being substituted in some cases for animal motive power.

The oases of Tripoli produce sufficient for the needs of the inhabitants in good years; but on the whole rather primitive systems of cultivation are in vogue, and in bad years a certain amount of importation takes place. In the steppe lands barley is the chief cereal. It is sown in November and harvested in April, and the average production is 500,000 hectoliters per year. Alfalfa grows without irrigation in all zones of the steppe land of Tripoli, but particularly in the region of Gerian, where there is an immense extent of land devoted to it. It is sold in the markets of Tripoli, Homs, Misurata, places two or three days' journey from the interior by camel transport. A special commission visited Tripoli, in 1913, and its report has furnished a basis for the development of experimental agriculture and for the improvement of agricultural methods. In 1914 an agricultural station was founded, and a study was made of indigenous agricultural methods that can best be applied by Italian immigrants settled upon the land. Protection from the wind is one of the problems that confronts the government, in addition to the improvement of irrigation methods, the selection and adaptation of different types of culture, the technique of cultivation and harvesting, and the introduction of new species. Dry farming has been studied and also the fixation of dunes that threaten the settled places in the oases.

A problem of first importance in the improvement and pacification of the country is the building of new lines of railways and roads and the consolidation of existing ones. In such a land particularly, where settled places are far apart and difficult to reach, the railroad is the prime desideratum in the extension of military authority. It also promotes agricultural production, and this in turn affects the settlement and steadiness of the indigenous population. Of telegraph lines 1,400 kilometers have been constructed, and 1,250 kilometers of roads. The erection of public buildings and the improvement of ports, particularly the port of Tripoli, have been made matters of primary concern on the part of the Libyan government. A considerable quantity of capital distributed among a score of commercial houses or associations has been invested in works of improvement and development. These developments have also stimulated the trans-Saharan commerce that formerly was under the control of the Senussi. The author gives elaborate tables of the commerce of Tripoli, the exports and imports by years from 1912 to 1917 inclusive, and detailed items of export.

A large part of the paper is concerned with the political relationships, especially important because it is only through the control by treaty or by military occupation and pacification of the desert interior that Italy can retain her hold upon the trans-Saharan trade, which

would otherwise find its way to the coast of Africa about the Gulf of Guinea, or eastward to Egypt. Though Italian colonies are established only in the coastal belt, the government looks forward to their occupation of localities farther inland, for the coastal region is almost entirely occupied by small indigenous proprietors. Until the interior can be made secure, Italian immigrants will hardly be tempted to advance into it. Italy in fact is fighting a war against the desert and has in her hands a number of distinct agencies. Roads and railroads constitute one agency, her treaty with the Senussi chiefs is a second agency, and her improvement of agricultural conditions that will tempt Italian farmers is a third. The example of the Italian farmer is helpful to the native. It tends to fix him upon the land, to make him less and less nomadic, and if he can work out his destiny with the Italian farmer the government hopes thereby to establish a fraternity of interest between Italian and native which can only result in the more rapid reclamation of the desert. As was said at the beginning of this note, such a policy will permit the penetration of Italian capital in Moslem territory through the whole Near East, an event Italy looks forward to with great anxiety and hope because of her natural lack of raw materials on her home territory. Moreover, Italy is not unmindful of the advantages of a successful penetration of the Mohammedan world in her dealings with France and Great Britain inasmuch as these two powers are neighbors on either side of Libya. In addition, by the Tripartite Agreement of 1920 between Great Britain, France, and Italy, an agreement that displaces various prior treaties and agreements, these three powers are to enjoy equality of commercial privileges in their respective spheres of influence in Anatolia, and Italy has her special interests recognized in so-called zone C, which extends from the Smyrna region, through southern Anatolia, including Adalia, eastward to the Taurus Mountains. Italy's position in the Mediterranean is thus made distinctly stronger politically and economically. There is now in contemplation the introduction in Tripoli of a régime similar to that already established in Cyrenaica. This would give a large measure of local government and would enable the indigenous control of population to continue and to develop. The difficulty is that in Tripoli there is no head of a religious fraternity whose authority is generally recognized, and therefore in dealing with the local sects and groups a decentralized form of control must necessarily be adopted.

**A Journey Across the Libyan Desert to Kufara.** In the July, 1921, number of the *Geographical Review* reference was made to the remarkable journey to Kufara (Kufra) lately accomplished by Mrs. Rosita Forbes, details of which are now available in the August and September numbers of the *Geographical Journal*. The journey was commenced at Jedabiya, south of Benghazi, on December 8, 1920. The season of the year was unfavorable because of the strong cold winds—one of the reasons why Bedouin travel is done in summer rather than winter. Night temperatures on the outward journey ranged from 3° to 8° C.; noon temperatures rose to 44° C., and the occurrence of cold fog is noted. The real adventure of the expedition began when the oasis of Jalo was left and the expedition entered on the seven-day waterless stretch, traveling through flat, featureless country devoid of vegetation, an "amazing brown flatness, utterly unchanging—an endless, monotonous expanse of hard sand mixed with very fine gravel." For this section all the camel food and firewood had to be carried. The hummocks and dunes marking approach to the first of the Kufara group of oases were eagerly looked for and were first sighted in the morning mirage; "about an hour after dawn in the southern deserts a mirage regularly reveals for a few minutes the country lying anything from 30 to 90 kms. ahead, according to the height of the existing features. The Arabs call it 'the country turning upside down'." The route taken was east of that followed by Rohlfs, and instead of striking Taiserbo the expedition arrived at Buseima, typically situated by salt marsh and lake in a hollow between sand dunes and tabular mountains.

South of Jalo the population of Libya is Zouiyas with a sprinkling of the negroid Tebus, the original inhabitants of Kufara conquered by the Zouiyas a century and a half ago. These Arabs of the Senussi stronghold are a "fanatical warrior tribe, bitterly hostile to the advent of strangers, suspicious, cruel, and treacherous." Mrs. Forbes of course traveled in disguise (as an Egyptian Bedouin) and under letters from the present head of the Senussi confraternity, but the position of the party was extremely precarious. The population of Buseima, numbering some 100 (that of Taiserbo is estimated at 200 to 300) proved definitely hostile, as did that of other oases. In Kufara proper, however, the party was well received and permitted to explore two of the centers—Taj, the sacred city, on cliffs overlooking the wadi, and Jof, the chief mart on the floor of the wadi. It was said that no rain had fallen

in Kufara for eight years, but water is found almost everywhere in the wadi at a slight depth; and, thanks to a careful system of irrigation, vegetable gardens as well as palm groves flourish. There is practically no grazing, and camels are date-fed. When the rains of Cyrenaica are abundant the camels may be taken thither. On the other hand when the rains fail caravans come to Kufara seeking date fodder.

The return journey was made via Jaghabub, 80 miles west of Siwa, by a route of 15 days' actual traveling with only one water place, three and a half days from the starting point. Noon temperatures (late January and early February) averaged 33° C., and at night there were three or four degrees of frost. During a sand storm the noon temperature registered only 16° C.; the next midday it rose to 50° C. Leaving Kufara the expedition passed through a rough country, crossing three ranges of low tabular hills. Sandy wastes followed; "for three days we walked across unchanging flat sand covered with minute brown gravel." Jaghabub, which was reached February 10, lies near the Egyptian border and is a *zawia*, or Senussi college, not a political center or market.

**Vegetationless Areas in the Libyan Desert.** In all the so-called desert regions of the earth there are few areas that can be described as absolutely devoid of vegetation. In the Desert of Atacama Ball saw "a land absolutely without a trace of vegetable life," a comment endorsed by another eminent botanist, Philippi, who there traversed two stretches of 10 and 25 leagues length respectively absolutely without vegetation. In the Libyan Desert en route to Dahkla oasis MacDougal traveled a whole day without seeing a single plant. Another barren tract is reported by H. Hamshaw Thomas in a short discussion of ecological relations in the northeastern part of the same desert (Some Observations on Plants in the Libyan Desert, *Journ. of Ecology*, September, 1921). The observations were made some 25 miles northwest of Cairo. At this point, a mile and a half beyond the westernmost arm of the Nile, the alluvial flat terminates abruptly against a gravel plateau the surface of which is composed of small, wind-polished pebbles of quartz or sandstone. Occasional sand dunes or gravel ridges capped with sand occur, and in places are found the remains of silicified trees probably of late Tertiary age. During the rainy season (January to April inclusive) short-lived annuals appear, but "at a period when the annuals had disappeared I have traversed several miles on patrols without seeing a plant." Perennials are few and far between, occurring chiefly on the sandy patches. The extreme dryness of the air during much of the year, the intense heat of the sun on the quartz pebbles, and the unfavorable nature of the soil appear to be the chief limiting factors to plant growth. In possible amelioration of the last condition the author notes the discovery of an obscure lichen, a form of plant life which may prove to be of more abundant distribution here than has been suspected.

## ASIA

**Some Geographical Aspects of the Problem of China.** The moment is opportune to call attention to an admirable and truly suggestive paper, "The Far Eastern Question in Its Geographical Setting," by Professor P. M. Roxby, of the University of Liverpool (*The Geogr. Teacher*, Vol. 10, 1919–20, pp. 82–90, 142–150, and 253–270). Professor Roxby's modestly stated aim "to chart some of the larger features of the field and to indicate a line of approach to the study of this great region" is to furnish material for an understanding of three great problems—the future of China (its future economic and political status), the competition of Eastern and Western countries in the world markets, the question of Oriental immigration into lands owned or controlled by "white" people.

Much of the difficulty of the Chinese problem is explained by the extraordinary combination of political weakness and social solidarity exhibited by the Chinese people. The basis of Chinese strength lies in the way in which the social and economic fabric has been adjusted to the land through long ages. "Farmers of forty centuries" have been tilling fertile alluvial plains under a monsoonal climate and hydrographic régime that necessitated much ingenuity of water control and irrigation device especially in the deltaic regions. To bring such a land under cultivation called for many arms and much organization, and centralized organization at that. The call for labor sanctioned the family cult. Professor Roxby indeed suggests an earlier basis in the patriarchal society of the western steppe lands whence, according to a commonly accepted theory, came the ancestors of the Chinese people. If this be so, they would bring with them to the valleys of northern China an instinct of family solidarity not less valuable for the new conditions of settled life. Thus "the value of a large family corporation received a new sanctity. It became endowed with the quasi-religious

attributes with which it is invested in Confucianism, a code emphasizing precisely those personal and social virtues which were already recognized as necessary to hold this particular type of society together." Hence the endorsement of a state which, appropriate enough at the time, can under modern conditions only be considered as one of overpopulation. Incidentally, however, population pressure seems to have bred a virile stock "accustomed to both long hours of labor and a low standard of comfort, inured to fatigue, and relatively immune from many diseases."

Other early civilizations were founded on a somewhat similar natural basis, Egypt and the several empires of Mesopotamia for instance; but, whereas in these regions of comparatively limited areas state control was absolute, in China with its vast area, its complicated topography, and its difficulty of communications Imperial authority was not incompatible with local autonomy, and that autonomy is primarily of the village, clan-family.

Through lack of the stimulus of contact with rival nationalities the isolation of China has proved another potent factor making against the development of nationalism. The physical barriers of mountain and desert have indeed been penetrated. Through Kansu and the Manchurian gates conquering invaders have come repeatedly, but they have always been assimilated to the mass of the people: China has been surrounded by peoples culturally greatly her inferiors. Conception of "the state as an object of patriotism and of the nation as the real unit of society" are nonexistent for the vast majority of Chinese. The lack of comprehension of the larger unit is seen in the oft-quoted anomaly between the honesty and efficiency of the Chinese in individual relations and the notorious corruption in public affairs and enterprises.

Shaping of the "amorphous" mass of China to a modern body politic involves the question of the preservation of her integrity. Considering the size and physical complexity of the country and the mixed racial origins of the people the unity of civilization and customs is unusual. Religious antagonism also is notably absent save in the steppe borderlands of Kansu and Shensi where a large Mohammedan population has created somewhat of a "northwest frontier" problem. The disrupting forces now in evidence appear to be founded largely on topographic isolation with associated difference of outlook. There are, however, other differences of culture and economy that have been concisely portrayed by Berthold Laufer in his often-quoted paper "Some Fundamental Ideas of Chinese Culture" (*Journ. of Race Devel.*, Vol. 5, 1914–1915). Particularly in the southeast with its complex topography is communication difficult. Canton has its maritime interests and is more open to ideas from overseas. Peking, on the contrary, is in close touch with the grasslands and tends to be dominated by military or quasi-military chiefs. Geographically it would seem that the balance between north and south might be held by the Yangtze provinces, stabilized by the great agricultural, industrial, and commercial interests of that middle region, with the obvious center of Nanking.

The sketch of social conditions in China is brought into higher relief by contrast with Japan. An outstanding fact in the political geography of Japan is the existence until recent times of an internal military frontier. Colonization of the islands by peoples migrating from the Asiatic mainland was accomplished slowly. At the beginning of the Christian era the frontier was south of the Kwanto plain in which are situated Tokyo and Yokohama. The colonization of Hokkaido (the recent change of name from Yezo, barbarian, is noteworthy) can only be said to have begun. Such a condition favored development of the military virtues and retention of a feudal system under military leaders. The force of the ancient patriotism was seen in the successful wars with China and Russia wherein the latest military strategy was associated with the prevailing spirit of *bushido*. The opening up of Japan found her with a leader class ready to embrace a new system of national policy and with the means for carrying it into execution.

Recognition of these deeply-rooted ancient social forces and their basis must be implicit in any study of the problems of the Far East. Professor Roxby has done a service in setting them forth so clearly as a preliminary to consideration of other geographical aspects of the present political situation upon which also significant suggestions are made.

**Flood Control As an Aid to Relief from Famine in China.** Dr. Charles K. Edmunds, President of Canton Christian College, contributes articles to the *Trans-Pacific* (June, July, August, October, 1921) and to *Asia* (June, 1921) in which he discusses the question of famine in China as caused by drought and flood. The present famine was due to drought, the culmination of three bad years. It may be compared to the catastrophes

of 1878 and 1832 when the same sections of Honan, Shansi, Shensi, Shantung, and Chihli were devastated. In analyzing the records of famine over a period of 1,000 years Dr. Edmunds finds that 800 widespread droughts occurred, 91 being of special severity. While such droughts cannot be eliminated, much might be done to mitigate their severity. There is need of afforestation and more scientific agriculture, of improved methods of transportation and irrigation, and greater knowledge of meteorological and hydrographic conditions, especially as connected with water control and thus with the prevention of famine by flood.

While the lower reaches of all the important rivers of China are subject to heavy flood, it is the Yellow River that is particularly affected. A recent survey of the problem here has been made by the American engineer John R. Freeman acting for the Grand Canal Improvement Board. The volume of the Hwang Ho is comparatively small as it enters the sea—the discharge at high flood is only half that of the Yangtze at low water—but the amount of silt carried is great, and with subsidence of the summer floods there is considerable deposition. During flood time, however, the river tends to re-excavate its bed in these temporary deposits. For instance, observations during the flood in 1919 showed that along 100 miles of its course the river had dug a bed 10 feet deep. It is estimated, in fact, that 99 per cent of the total load of sediment is carried out to sea. This suggests the solution proposed by Mr. Freeman. He would straighten the course of the river, confining it in a narrow channel by new dikes and thus compelling it to scour its own bed. Water for irrigation would be drawn off by pipes through the dikes at suitable points; and much land now waste, including that between the old and proposed dikes, might be reclaimed.

The Hwang Ho, by usurping in past times the courses of the Wei to the north and the Hwai to the south and raising their beds, has diverted their courses. The former now flows to the sea through the Hai Ho at Tientsin, the latter reaches the Yangtze via a system of lakes draining to the Grand Canal. The Hwai in particular offers hydrographic problems. The lower basin is exceedingly flat, and the river is furthermore prevented from finding a new course eastward to the sea by the Great Maritime Dike built 1027 A. D. and the dikes of the Grand Canal. Streams draining from the Shantung hills to this portion of the North China plain are also held back and during flood contribute to the excess of water carried to the Yangtze. The proposal for control is similar to that for the Hwang Ho. It involves the construction of a straight channel confined by strong dikes whereby the flood waters from the entire area can be united and carried off direct to sea. At the same time some of the lake areas could be drained and given over to agriculture, others could be improved as storage reservoirs for irrigation purposes. Afforestation in Shantung and the creation of reservoirs in the borders of the hills would further aid regulation of flood waters. Included in the drainage problems of the plain between Hwang Ho and the Yangtze Kiang is rehabilitation of this section of the Grand Canal and thereby a material help to communication.

**A Recent Study of Life Zones in Southeastern Asia.** The belt of very deep valleys and high mountains compressed within narrow limits between the two great elbows of the Yangtze Kiang on the east and the Brahmaputra on the west was long a region of uncertain physical geography. The explorations that have revealed its character are matters of recent times and are still far from being complete. Their chief result has been to lay down upon the maps the principal orographic lines and the courses of the three closely spaced and parallel streams that drain the area—the Irrawaddy, the Salween, and the Mekong.

Among the important contributory explorations are those of the naturalist F. Kingdon Ward, the results of which have appeared in a number of books and articles, the latest being the volume "In Farthest Burma" (1921). A hydrographic study recently discussed in the *Geographical Review* (Vol. 7, 1919, pp. 413–415) is now followed by "The Mekong-Salween Divide as a Geographical Barrier," (*Geogr. Journ.*, Vol. 58, 1921, pp. 49–56) which describes the region in further detail, and we now have the relief features for the first time brought into something like an accurate relation to the distribution of life. One of Captain Ward's main contentions is that we have here a quite distinct contrast to the life conditions that obtain in the Himalaya Mountains. In the matter of control over major distributions the Himalayan ranges form part of the boundary between the Oriental and Palearctic regions. East of the elbow of the Brahmaputra the line of separation between northern and southern faunas is the Yangtze-Yellow River divide, or watershed, except for the ten degrees of longitude between 95° and 105°, where no clearly defined boundary exists owing to the north-south trend of the mountains and valleys within the aforementioned narrow belt. If the Mekong-Salween divide, and the parallel chains, break the

continuity of the major line between northern and southern life forms and confuse distributions and boundaries, they also, because of their southward trend over nearly fifteen degrees of latitude, form a dividing line between two subdivisions of the southern, or Oriental, belt that extends from the Arabian Sea to the Pacific. Of this fifteen degrees five hundred miles are highly effective boundary, though the northern and southern ends are less so. "The faunas of the Indian and Chinese subregions of the Oriental region are in fact surprisingly different." The boundary between the two is the Mekong-Salween divide, and it is this feature rather than the north-south migration and commingling of Oriental and Palearctic forms that is the chief distinction of the narrow mountain belt under consideration. The author lists a half dozen animals characteristic of the typical Indo-Burmese fauna that are not found east of the Salween.

In the northwestern part of the narrow belt under consideration, namely in the unexplored Salween-Brahmaputra divide region, there appears to be a transference of the function of a faunal and floral barrier from the Salween range to the Salween-Brahmaputra divide. This transference of function takes place at the 28th parallel, but toward the northwest its details have still to be worked out by further exploration. Hardly less marked is the effect of the Mekong-Salween divide in cutting off an eastern Asiatic floral region. Many genera and species are confined to the western side of the barrier; and many others are poorly represented east of the barrier, both in species and numbers. Likewise a number of plants east of the Mekong do not cross the divide to the west. Only at the southern end of the barrier, where the mountains are lower, is there intermingling in a broader zone.

The author would recognize in southeastern Asia a new subregion among Asiatic life zones, to be called Sino-Himalaya. "This would comprise the Himalayan and perhaps Trans-Himalayan ranges as far north as the Salween; the Burma-Yunnan ranges as far east as the Mekong down to the twenty-first parallel of latitude; and mountainous western China as far east as the province of Hupeh northwards to the Yellow River. This mountain region has a common flora and fauna and is characterized by many endemic genera. It cannot conveniently be treated as part of the eastern Asiatic region on account of its strong Indo-Malayan connection; similarly its Palearctic connection is vitiated by its Oriental relationship. On the other hand it is characterized by numerous endemic mammals. . . ."

## AUSTRALASIA AND OCEANIA

**The Origin of the Salt Deposits of South Australia.** The origin of the salt deposits of South Australia is discussed by R. Lockhart Jack in a report on the salt and gypsum resources of the state (*Geol. Survey of South Australia, Bull. No. 8*, Adelaide, 1921). Salt is widely distributed throughout South Australia, as is the occurrence of saline ground water. At present the chief deposits worked are in Yorke's and Eyre's Peninsulas and Kangaroo Island. The lake basins, or playas, contain water from a few inches to several feet deep during the season of winter rains, and with the disappearance of the water in summer there is reaped the salt harvest from a crust ½ inch to 3 inches thick. The workability of deposits farther inland is dependent on improvement of transportation facilities. Since construction of the Transcontinental Railway exploitation of Lake Hart and other interior basins has begun.

Three theories are advanced in explanation of the deposits. The first derives the salt from beds of rock salt leached by the accession of ground water during the rainy season, the second from "fossil" salt held in the interstices of the marine beds during deposition. Neither of these theories is supported by the geological facts as known today. The southern portion of Yorke's Peninsula may be taken in illustration. Overlying basal rocks of Pre-Cambrian age is a relatively impervious argillaceous Permo-Carboniferous till, overlain in turn by patches of Tertiary limestone, clays and sands, the last of eolian origin. The capping layers are thin, averaging less than 20 feet, relatively porous and capable of absorbing the whole normal rainfall. Wind action, erosion, and solution have excavated numerous pans, or lakes, whose bottoms are formed by the impervious till thus affording excellent opportunity for the accumulation of salt. In none of the beds is rock salt known to occur. Salinity of the waters held in the beds may be explained by impregnation from above. In fact, in rocks of every type and geological age in South Australia, wells and mines have yielded both fresh and saline waters. "Fossil" salt could hardly be held in the till: from the thin porous Tertiary beds it would apparently have been leached out long ago or, if held in such condition as to be released only on erosion of the containing rock, would be available

only at a very slow rate. It appears, however, that there is no definite proof of decrease of output; though the amount fluctuates according to seasonal conditions. The salt is said to be of "cyclic" origin, derived from the evaporation of sea spray in the air, blown over the land and washed down to the surface by rains. Thence it may be removed by the run-off, may be left in the soil by evaporation, or may be carried down to the ground water making the latter more or less saline and, where topographic and geologic conditions are right, contributing to the formation of salt lakes. Climatic conditions are highly favorable to genesis of the salt deposits. The rainfall is small and run-off is correspondingly feeble. Rains are seasonal, falling during the winter in the form of numerous light showers. The average for Yorke's Peninsula is 17.5 inches distributed over 100 days. Evaporation is high. The 50-inch line of net annual evaporation crosses the head of Spencer Gulf.

The association of gypsum with the salt is so marked as to suggest community of origin. It seems probable that a large proportion has been carried over from sea water with the cyclic salt. With the gradual concentration of the water in the salt lakes the gypsum crystallizes out and subsequently, where not protected by a layer of the hygroscopic salt, is blown by the desiccating northerly winds to form belts of gypsiferous earth or even dunes at the southeastern ends of the lakes.

**Dust Whirls in Western Australia.** In the Proceedings of the Royal Society of Victoria (Vol. 32, 1920, pp. 314–322) J. T. Jutson, who has written on various phases of erosion under arid or subarid conditions in Western Australia, briefly describes the dust whirl as a factor operating therein. Dust whirls, as Mr. Jutson points out, have been described by W. M. Davis (Elementary Meteorology) and E. E. Free (*U. S. Dept. of Agric. Bur. of Soils Bull. 68*, 1911), the latter giving a useful list of references; but there are few recorded descriptions of their occurrence in Australia. The present paper notes the occurrence of 43 dust whirls in Western Australia, where they are locally known as "willy-willies," and describes one in full. The whirls were observed in the northern part of the Coolgardie gold field in a subarid region (rainfall averaging 10 inches or less). The whirls were of varying height—from a few feet to some thousands—and varying diameter. They appeared as columns rotating in clockwise or anticlockwise direction, the latter predominating, and moving in linear directions. They were commonest in the summer and on days of calm or of only light airs. Even the smallest whirls were violent in action, and it is evident from their numerous occurrence that they must accomplish a great deal in the way of erosion and transportation. Dust is carried high and far and undoubtedly is "exported" from the place of origin to add to the thickness and mixed character of the soils outside the region. Sand settles locally, tending to drift in the hollows and contributing to the shaping of the vast high level plain of the south-central section of Western Australia.

## PHYSICAL GEOGRAPHY

**Peat Deposits As Evidence of Climatic Change.** The realization that climate is by far the most variable geographical factor is leading to a constantly increasing study of climatic changes. One of the interesting phases of this study is the way in which new lines of evidence are being sought out. To the ordinary eye all the layers of a peat bog seem much alike unless marked by sand, clay, or stumps. The specialist, however, finds that equally important phases are indicated by numerous less obvious conditions. For example, where the ordinary fibrous matter of peat is mixed with large amounts of decomposed or macerated material a condition of high water and abundant rain is indicated. Where the material is almost purely fibrous, no matter whether it forms fine threads or is coarse and woody, relatively dry conditions are usually inferred. Again, the chemical structure of the peat, that is the extent to which it is colloidal, or impregnated with lime, shows the degree of concentration of salts in the water and thus furnishes a key to the climate. In addition to this, microscopic examination of the traces of leaves, pollen, seeds, and other plant materials, washed or blown from surrounding trees, reveals unmistakable evidence of the climate in the regions surrounding the bog.

On the basis of such criteria Mr. A. P. Dachnowski has been making a study of the peat formations of the eastern United States, especially Ohio (Peat Deposits and Their Evidence of Climatic Changes, *Botanical Gazette*, Vol. 72, 1921, pp. 57–89). By correlating the peat bogs and the moraines along a line running northward from Canton to Cleveland, Ohio, he finds evidence of an irregular series of climatic changes since the last glaciation. While the author's conclusions are as yet purely tentative, they are of considerable interest for

comparison with conclusions based on other evidence. As nearly as they can be defined the main stages since the height of the last glaciation are as follows:

1. The cold period of the main advance of the Wisconsin Ice Sheet.

2. "A time during which a cool and dry climate bordered closely the glacial regions." This period was apparently double, there being a break in the middle. "It was probably a period of winds, cool from the ice sheet, and of loess deposition." On the glacial till left exposed by the retreating ice, marsh plants and low shrubs appear to have been the only dominant plants.

3. A second great advance of the ice, the Later Wisconsin, probably not so severe as the first.

4. "A prolonged warm and humid climate—this appears to have been the period of invasion and wide dispersal of forest trees from the south and of a more northerly distribution of certain species than is now recorded for them." This period, it should be noted, resembles the warm, humid period which Brooks, as explained elsewhere in this number of the *Review*, places at 4000 B. C. Dachnowski, however, gives no clue to its date. It may be earlier than 4000 B. C.

5. "A return to cooler and drier climate."

6. "A temperate and more humid period than exists at the present time in the same localities."

7. "The present period is probably approaching a climate of rising temperatures and (or) decreasing precipitation. The botanical data, however, are as yet insufficient to permit more definite conclusions, and they are wholly inadequate for drawing a parallel between the past climatic conditions of different countries."

Although Dachnowski's studies are only preliminary, they agree with those of a constantly growing body of investigators in showing not only how numerous the climatic pulsations have been since the glacial period, but how far toward our own day they continue.

ELLSWORTH HUNTINGTON

## GEOGRAPHICAL NEWS

**The Centenary of the Geographical Society of Paris.** In July last the Geographical Society of Paris celebrated the centenary of its foundation. The several functions included a meeting presided over by the President of the Republic and attended by representatives of official institutions and learned societies, among them a number of foreign geographical societies. Mr. W. L. G. Joerg represented the American Geographical Society. The opening of the meeting by M. Millerand was followed by addresses by Prince Roland Bonaparte, President of the Society, the Vice-President, M. Henri Cordier, Sir Francis Younghusband, President of the Royal Geographical Society, and other distinguished guests by whom tribute was paid to the work of the Society. The Geographical Society of Paris has been closely associated with the colonial and economic expansion of France that, following the Restoration and the general peace of the second decade of the last century, has been maintained ever since. French geographers and explorers have played an important part in the opening up of Africa and the creation of a great French Empire therein, and this is reflected in the wealth of African material contained in the publications of the Society. The Society has consistently given support to African exploration from the time when the award of 10,000 francs, offered to the first French traveler to set foot in Timbuktu, was made to Caillé in 1828. Recent expeditions organized by the Society include the Foureau-Lamy mission across the Sahara to the Congo (1898), the Lenfant mission to the Niger-Benue-Chad region (1903), the mission for the study of sleeping sickness (1906), the mission to the Ivory Coast for geodetic and forestal studies (1908), and the scientific mission to Morocco. The Ollone mission to western China (1906), was instituted by the Society, which has also had part in other important Asiatic explorations.

At home the Society has been responsible for the creation of provincial geographical societies (after the decentralization movement of 1870) and the Society of Commercial Geography of Paris (1876). Besides numerous special publications the Society has published its bulletin continuously from 1822, since 1900 under the title of *La Géographie*. The centenary is commemorated in a special number, July-August, 1921.

**The Explorers Journal, A New Publication.** The first number of the *Explorers Journal*, a publication of the Explorers Club appeared in November of last year. The *Journal* which will be issued monthly is primarily designed to keep members, especially non-resident members fully informed of the affairs of the Club.

The first number details the plans for purchase of a new club house at 47 West 76th Street and announces a series of symposia on the technique of exploration to be held during the winter. Notes on current exploration will be an important feature of the *Journal*.

## OBITUARY

William Speirs Bruce, the distinguished Polar explorer and naturalist, died in Edinburgh on October 29, 1921, at the age of 54 years. Dr. Bruce began his career of Polar exploration as naturalist to the Scottish Antarctic expedition of 1892-1893. He acted as zoölogist to the Jackson-Harmsworth expedition to the Arctic, 1896-1897, and as naturalist to Major Andrew Coats's expedition to Novaya Zemlya and the Barents Sea in 1898. He was leader of the *Scotia* (Scottish National Antarctic) expedition of 1902-1904 and editor of the reports of the scientific results, several volumes of which have appeared. As an explorer Dr. Bruce's name is also particularly associated with the Spitsbergen archipelago to which he made a number of journeys, the first as naturalist to the Prince of Monaco's expedition of 1898-1899, the last in 1920. As founder and director of the Edinburgh Oceanographical Laboratory Dr. Bruce has carried on in worthy fashion Edinburgh's traditional interest in modern oceanography. In 1920 he was awarded the David Livingstone Centenary Medal of the American Geographical Society, an account of the presentation of which appeared in the July, 1921, number of the *Geographical Review*.

Manuel Vicente Ballivián, the eminent Bolivian publicist and geographer, died in La Paz on August 7, 1920, at the age of 73. The greater part of his life had been spent in service of the state, first in the Bolivian Legation at Paris, then acting successively as commissioner of the territories of northeastern Bolivia—where he carried out a series of arduous explorations—, as head of the Department of Immigration and Statistics, and as minister of Colonization and Agriculture, in all of which capacities he constantly labored to promote the geographical and economic knowledge of his country. It was in recognition of his notable accomplishments in this field that he was awarded the David Livingstone Centenary Medal of the American Geographical Society in 1917. Señor Ballivián was president of the Geographical Society of La Paz and author and editor of numerous works on Bolivian history and geography.

# GEOGRAPHICAL REVIEWS

## The Racial Problem in World-Politics

Lothrop Stoddard. **The Rising Tide of Color Against White World-Supremacy.** With an Introduction by Madison Grant. xxxii and 320 pp.; maps, index. Charles Scribner's Sons, New York, 1920. $3.00. 8½ x 5½ inches.

Few phenomena are more interesting than the waves which mark the progress of civilization. During recent centuries one of the greatest waves has been that of self-government which perhaps reached its height in the World War. Another was the wave of universal education which is still supposed by many to be the panacea. A third is the wave of mechanical invention, transportation, and the physical mastery of nature. These three waves have put the world in a state of biological and social chaos whose importance is only gradually being realized. In the attempt to bring order from this chaos there have arisen two other waves which bid fair to be dominant factors in the next century. One is the insistent call for sound health as the basis for meeting the conditions arising from emigration, manufacturing, city life, and all the other new environmental features. This wave is discussed in Professor Binder's "Health and Social Progress," reviewed elsewhere in this issue. The second wave is that of eugenics. It has reached the stage where the work of the pioneers like Galton is succeeded by books like Grant's "The Passing of the Great Race," and Humphreys' "Mankind."

To these popular attempts to arouse the world to a sense of impending danger Lothrop Stoddard has recently added another. The gist of Mr. Stoddard's book is that modern transportation has brought the various races of the world into much closer contact than ever before. Hence old political and racial rivalries are intensified, and new ones arise. Only when transportation has had time to do its complete work will the world settle down into a state of relative stability. What race will then dominate the world no man can say, but the white race will no longer be dominant unless it looks well to its laurels.

That the world is passing through a great crisis and that the composition of races is one of the most vital factors in determining future events can scarcely be doubted. Whether the crisis really takes so alarming a form as is supposed by Mr. Stoddard remains to be seen. After an introduction in which Mr. Grant restates some of the conclusions of "The Passing of the Great Race," Mr. Stoddard divides his book into three parts: (1) The Rising Tide of Color; (2) The Ebbing Tide of White; (3) The Deluge on the Dikes. In the first he discusses the colored races. He shows how the yellow man, the brown man, and even the black man and the red man have been gradually aroused to a certain degree of self-consciousness by contact with the white man and especially by sharing in the World War and by the knowledge thus gained of the white man's weaknesses and losses. Numerous quotations show that the Hindus, the Chinese, and especially the Japanese are restive under the white man's arrogant assumption that the world belongs to him. The quotations are highly interesting, and Mr. Stoddard is to be congratulated on his ability in finding and using them. Nevertheless, he perhaps takes the newspaper fulminations of a few agitators more seriously than they deserve to be taken. If he had lived or traveled extensively among the colored races he might feel more strongly the difference between the small group of agitators who go so far as to talk of a "Pan-Colored" alliance against the white man, and the enormous body of the common people who show little if any sign of being roused from their age-long apathy. Only in Japan is there any serious departure from this condition, but Japan was the most progressive of the so-called "colored" countries long before it came into contact with the white man, and its spirit is more like that of Europe and America than that of Asia.

In the second part of his book Mr. Stoddard summarizes the achievements of the white race, its marvelous expansion in numbers from perhaps 70,000,000 in 1500 A.D. to 550,000,000 in 1900 and the remarkable expansion of its power over almost the entire earth. Against this he places the losses of the World War and the evidences that the white man's disregard of eugenic precepts is gradually weakening his power.

Finally in "The Deluge on the Dikes" the author speaks of the outer dikes as the regions where white men exercise political control but there is no settled white population. He points out the strength of the agitation against white control in Asia and says in conclusion: "That this profound Asiatic renaissance will eventually result in the substantial elimination of white political control from Anatolia to the Philippines is as natural as it is inevitable." This conclusion he bases on the idea "that men worthy of independence will sooner or later get independence." Therefore, since the yellow men and the brown men by their past achievements have shown themselves worthy of independence, the best thing the white man can do is to move out of Asia with as good grace and with as little conflict as possible. But he must not let the brown Arabs overrun Africa and the yellow Chinese overrun Latin America. That would bring the colored peril close to the inner dikes—the places where the white man actually lives.

The "colored" peril has three parts: the peril of arms, the peril of markets, and the peril of migration. Mr. Stoddard recognizes that the peril of arms is slight except under certain almost impossible contingencies. The peril of markets seems to him more important, for he holds that the yellow people have the capacity for manufacturing as well as the white people. This may be true in Japan though it is doubtful in the rest of Asia. The question is not only whether the yellow men have the innate capacity, but whether the climate and other environmental features under which they live permit the constant energy and mental alertness which seem to be indispensable for the higher types of manufacturing. As to the peril of migration the case seems clearer. Mr. Stoddard may not be right in saying that all the white man's "marvelous achievements are due solely to heredity," for the fact that aside from Japan the white man occupies all the regions where the physical environment is highly favorable may have a great deal to do with the matter. Nevertheless, the greatest danger which today confronts the white race in general and the United States in particular is probably the dilution of a fine, capable racial inheritance with stocks of less capacity, both white and colored. In the clear and forceful manner that is characteristic of his entire book the author points out that "the East can *underlive* the West" and thereby drive out the westerners wherever the two attempt to compete on equal terms. This is true not only of Asiatics but of eastern and southern Europeans. Whenever such people mingle with those of higher heredity, they do not lift the superior type to a higher social level, as is often supposed, but actually drive it out, or rather prevent it from being born, as is rapidly happening in New England. This is not because the lower type is biologically the "best" but because it is willing to increase and multiply regardless of its own standard of living and that of its children. The higher types, on the contrary, refuse to lower their standards by rapid multiplication and therefore die out. The forceful way in which this great truth is brought out makes Mr. Stoddard's book deserve not only careful reading but careful thought in order that its conclusions may be acted upon.

ELLSWORTH HUNTINGTON

## MODERN ITALIAN EMIGRATION

R. F. FOERSTER. **The Italian Emigration of Our Times.** xv and 556 pp.; indexes. (Harvard Economic Studies, Vol. 20.) Harvard University Press, Cambridge, 1919. $2.50. 9 x 6 inches.

Studies of present day migrations are being added one by one to the materials of the student of the humanities. The volume in hand represents a marked advance over its predecessors and contemporaries in at least three particulars. Instead of considering the immigration of a given national group into one country only, it adopts the standpoint of the migrating people, whose separate currents of movement over the world are chronicled as distributaries of one great stream; instead of being written by an apologist for or a historian of this or that nationality, it is the work of a student of social affairs whose breadth of approach gives it the stamp of catholicity; instead of being written from personal information combined with reference to a limited range of written sources, it is the product of prolonged and extensive study of voluminous and widely scattered documentary material, corroborated by some field work.

The reader will not lay the book aside without regrets: he will wish that evidence collected from diverse and unequally authoritative sources might have been more nearly harmonized, or at least that he had been given a thread to follow through the maze of confusing and contradictory facts; he will feel that more intensive field work in Italy would have repaid the

necessary effort; and he may take issue with the tendency to put a better face on the movement than the evidence of the documents warrants.

The work leaves little to be desired in certain respects: as a repository of much exceedingly useful information, no small part of which has been beyond the reach of most students in the United States; as an example of organization which might be followed profitably in dealing with other great migrations of this age; and as formulating certain general conclusions with respect to such migrations, which, if tentative as yet, may prove to be fundamental when the evidence from other emigrations is available.

The outline of the material is simple, and its key is furnished by an admirable topical table of contents. Following some forty pages of summarized conclusions, which seem heavy with statistical facts until reread in the light of the more extended subsequent treatment, is an inquiry into the causes of migration, within typical sections of Italy and within every foreign country whither Italians have gone in significant numbers. The marked contrasts between emigration from northern Italy and emigration from southern Italy, the broad similarities of the separate movements into European countries, the significance of the settlement in North Africa, and the striking differences between South American and North American immigration, are set forth in the midst of a rich store of detailed information as to the extent and character of the migrations. The final hundred pages of text deal with the motives of the individual migrant and with the private and public consequences of his activities.

Although the book is primarily a study in the field of social economics and therefore stresses the business of wresting a living from foreign and not always hospitable communities, neither the geographic basis nor the moral and political consequences of this business have been neglected.

The geographer will find the richest offerings in chapters three, four, and seven, which deal chiefly with the conditions of the natural environment in Italy. The ultimate potent cause of emigration is seen to be the lasting inferior economic position which Italy holds in comparison with her neighbors in western Europe, or with the American countries. This inferior economic level affects the people mainly through backward and handicapped agriculture (the principal occupation of the country); and the conditions which hamper agriculture are (1) water erosion and avalanches in the uplands, (2) deposition of gravel on, inundation of, and malaria in the lowlands, and (3) aridity everywhere. Undeniably all these untoward conditions are worse today than formerly. To account for the deterioration the hypothesis of climatic change is suggested but is expressly left aside as unneccessary to the argument, which is rested upon known deforestation which took place during the eighteenth and nineteenth centuries. As a result of this deforestation the seasonal torrential rainfall has produced the discouraging conditions enumerated above, which in turn have enforced extensive agriculture, have resulted in niggardly crops, have compelled the peasants to live in the uplands and to traverse long distances to their work on the fertile but malarial lowlands, and, by depopulating these lowlands, have made possible open field brigandage. Rarely have the economic and social consequences of a geographic condition been traced in such detail.

From southern Italy, where the evil consequences of deforestation are most apparent because of the unsatisfactory distribution of rainfall, emigration first took place from the populous uplands, where agricultural land was scarce, and among those who received a medium wage and who were therefore able to get away and yet were not tempted to remain. From northern Italy, nearness to more favored countries which could offer better pay than the homeland seems to have been the magnet of attraction. The emigrants from both sections have served mostly as unskilled laborers, either on the soil in Argentina, Brazil, and North Africa, or as construction hands and the like in the United States and in continental Europe. In France, Germany, and Luxemburg they perform the most laborious tasks in the steel mills and mines. Those who are skilled workmen are mostly miners, quarrymen, and stonecutters, adhering to trades which they learned in producing their native extensive mineral wealth. Fruit vending is popular among those who assay business for themselves, particularly if they be Sicilians. In the Plata, along the African littoral of the Mediterranean, and off the Dalmatian coast, the fishing is chiefly in the hands of Italians—Chioggian in the Adriatic, Ligurian elsewhere.

The later chapters contain numerous additional references which throw light on the economic geography of this or that country of immigration, but the materials for political geography are more considerable. Pages 212–222 on North Africa illuminate the well-

known quarrel between Italy and France over Tunis with facts which most historians have failed to note; the discussion of the work of Italians in effecting an economic and political renaissance in Argentina is a vital study in the comparative influence of environment and tradition (which is itself, in one view, a product of past environment); Chapters 22 and 23, dealing with the effect of emigration on general Italian foreign policy, show that Italian national imperialism is bulwarked by, if not sprung from emigration.

The chapters on the United States are almost purely economic in scope. Italian emigration thither is recent, and most of it is seasonal and transient. Consequently there has been little opportunity for reactions by or upon the environment. Perhaps because of this situation Italians in the United States disclose sharply a trait common to their compatriots elsewhere—they carry to their new homes the regional antipathies and separatist tendencies which are the product of age-old geographic separatism within Italy.

Each of the chapters on the countries of immigration contains valuable statistics of the geographic and occupational distribution of immigrants within the country and of their origin within Italy. Figures on emigration appear in the first two chapters of the volume and in the Appendix. All these may be found readily with the aid of the general index, which is unusually well prepared. The special student will find materials well in hand in the two-column bibliographical index of nine pages. Nearly every page of the text is elaborated with footnotes containing quotations from the sources.

Combining careful workmanship, broad scholarship, and readability, the work proves that romance need not be excluded from a work of erudition, provided the subject is a vital one.

D. S. WHITTLESEY

## RECENT BOOKS OF TRAVEL IN ASIA

EDMUND CANDLER. **On the Edge of the World.** 278 pp.; map, ills., index. Cassell & Co., Ltd., London, New York, Toronto, and Melbourne, 1919. 8 x 5½ inches.

ELLA AND PERCY SYKES. **Through Deserts and Oases of Central Asia.** xii and 340 pp.; maps, ills., index. Macmillan & Co., Ltd., London, 1920. 21s. 8½ x 5½ inches.

A. DE C. SOWERBY. **Sport and Science on the Sino-Mongolian Frontier.** xvi and 295 pp.; ills. Andrew Melrose, Ltd., London, 1918. 8½ x 5½ inches.

S. POLLARD. **In Unknown China: A Record of the Observations, Adventures and Experiences of a Pioneer Missionary During a Prolonged Sojourn Amongst the Wild and Unknown Nosu Tribe of Western China.** 324 pp.; maps, ills., index. J. B. Lippincott Co., Philadelphia; Seeley, Service & Co., Ltd., London, 1921. 25s. 9 x 6 inches.

R. C. AND Y. B. ANDREWS. **Camps and Trails in China. A Narrative of Exploration, Adventure, and Sport in Little-Known China.** xxv and 334 pp.; maps, ills., index. D. Appleton & Co., New York and London, 1920. $5.00. 8½ x 6 inches.

These books of travel, all well illustrated, have in common the fact that they deal with frontier regions on the marches of the old Chinese Empire. In each instance the peoples dealt with arouse particular interest in the traveler from their contrast with neighboring folk, and in each region Nature is impressive—wild mountain country or desert wilderness. If it is the "sun-baked, barren ridges, the shifting, windswept sand-dunes, and the saline, brackish swamps of the Ordos Desert" that cast the strongest spell on Mr. Sowerby, Mr. Candler in "On the Edge of the World" succumbs to the glories of the mountains "back of Kashmir." The latter author has produced a delightful volume. He touches traditional phases of Indian life and landscape but in such a charming and whimsical manner that the most ordinary subject is given new life. To his writing he brings much of the insight and philosophy of a Kipling and a scientific knowledge and interest. Mountains and pilgrims and pilgrimages are his main themes. The sacred places of the high mountains, the cave of Amarnath, the lake of Gangabal call forth sympathetic description; with its degenerate priests, the shrine of Jawala Mukhi, the Sacred Flame, in the foothills back of Amritsar evokes an unattractive contrast. Of special interest is the visit to Nanga Parbat "a wild country and a wilder people"—mountain raiders who terrorize the Kashmir peasantry. Particular mention may be made of the excursion to the Rakiote glacier, previously visited by Mummery, Bruce, and Collie with whose reports its present aspect is compared. There are also a couple of journeys in Persia—on the old Baghdad-Kermanshah road and in the Bakhtiari foothills.

In "Through Deserts and Oases of Central Asia" the authors have extended their Persian field of travel to the Pamir and Chinese Turkestan. Chinese Turkestan is a curious mixture of Russian, Chinese, Hindu, and Moslem customs and religions, for it is not only a frontier region but through it runs the great ancient road from China to the Occident. The population of this vast plain, 1000 miles from east to west and half that distance from north to south, is estimated at 1,500,000, mostly confined to the oases that form only 1½ per cent of the entire area. Its two types, settled and nomadic (with a small semi-nomadic division), are administered separately by the Chinese government. Details of the history and geography of the land are given by Sir Percy Sykes in the second half of the book: the first half written by Miss Sykes is narrative.

Mr. Sowerby, joint-author with Robert S. Clark of "Through Shên-Kan" (Shensi-Kansu), has continued his explorations on the Sino-Mongolian frontier—that is the frontier as defined by the Great Wall, which to a great extent follows the natural boundary rather than the present political boundary. The work done was in the nature of scientific and geographical research, including the collection of biological specimens, the making of geological notes, the carrying out of compass traverses (unfortunately the exigencies of wartime publication prevented inclusion in the volume of the promised map), and general investigation into the lives, customs, and conditions of the natives. Regarding the last field the author, who was born in China and knows the people and their language, makes observations specially interesting at the present time. The Mongols he describes as a wretched remnant of a noble people degraded by a degenerate religion until they bear no resemblance to the tribes that under Jenghis Khan swept Asia and eastern Europe in a conquest that has never been equaled. Along the border the Chinese are steadily advancing, pushing further and further into Mongol territory. The several explorations are described in separate chapters, and there are also chapters on the biological work and on the flora and geology of the region.

The "Unknown China" of Mr. Pollard is the country he styles the home of the Yangtze Kiang, Nosuland, a semi-independent district of Szechwan bordering on Yünnan. The connection with the Government is chiefly the sending of tributes, one of which consists of the yearly despatch of forty-eight horses to Peking—at least the Nosus start them on the journey leaving it to the petty officials en route to decide whether they shall ever reach their destination. Among the aboriginals of China the Nosuland tribes are unique in that they possess a written language, ideographic like the Chinese but bearing no other resemblance to it. A completely organized feudal system is in vogue.

Mr. and Mrs. Andrews have written an account of the Asiatic Zoölogical Expedition of the American Museum of Natural History to China in 1916–1917. The destination of the expedition was the remote border province of Yünnan. The route was by way of Shanghai and Foo-chow with a brief stop-over in Fukien—an unsuccessful attempt to secure a specimen of the so-called "blue tiger." Ethnographically Yünnan is interesting as the seat of some thirty semi-independent non-Chinese tribes, some of whom represent the original inhabitants of China. It maintains a rather indifferent attitude towards the affairs of the government, with which it has little connection except through the media of tax collectors and other petty officials. The people are simple, kindly, hospitable, with a wealth of interesting folklore. The collection of 3,300 specimens and a large number of photographs and picture films is reported. The scientific results will be published by the Museum. From the present volume, which has the character of a popular narrative, details of scientific interest have been largely eliminated.

## The Economic Geography of Siberia

Richard Pohle. **Sibirien als Wirtschaftsraum. Eine Einführung in das Leben Sibiriens.** viii and 66 pp.; map, bibliogr. Kurt Schroeder, Bonn and Leipzig, 1921. 9 x 6 inches.

Richard Pohle has to his credit a number of regional studies that are as thoughtful as they are brief and unpretentious. The essay under consideration is fortified at every turn by statistics and references to vital sources. At this time the Siberian realm is of special interest because the character of its development will depend largely upon the outcome, ultimate as well as immediate, of the Washington conference on the limitation of armaments and Far Eastern questions. Pohle regards Siberia as a house with two fronts: an eastern, which is still free for possession by the strong, and a western, which is irretrievably held by Moscow. The effect is to deny to West Siberia an outlet to the world-encircling and commercially life-

giving sea, an outlet that alone could give that region a distinctive culture and a modern industrial and social organization. It is still a *colony* of Europe and will long remain in that relation. It is the strength manifested by these restraining forces in the past that gives a sure clue to future development. Fighting against a close and distinctive organization of Siberian life are the great distances between Siberian centers of trade and life and between Siberia and the main life currents of the world. Too much space must be overcome. Too much space, economically useless at the present time, separates the areas of profitable production. The separatist tendencies of East Siberia are seen in the formation there of a republic two years ago. Midway between the eastern and western division of Siberia is a nodal area—the Lake Baikal region. An old trading mart, far removed from the seats of power, the life of Irkutsk and the region round about is freer from political considerations than that of the eastern or western marches. The Trans-Siberian railroad completed in 1905 has connected these dissimilar geographical elements, and it is indeed a very slender band of union.

Under these conditions the eastern border bids fair to become the scene of infiltration and possibly of possession by the yellow race, while the western border will long be traversed by eastward-moving cultural and political agencies. In the four-year period from 1907 to 1910, inclusive, Japanese fishing ships in Russian waters increased from 109 to 301, their tonnage from 11,675 to 49,307, and the number of fishermen from 1,174 to 7,332. In the same period the Russian fishing stations on the Okhotsk-Kamchatka coasts increased from 4 to 22 and the Japanese from 70 to 127. And four-fifths of the Russian catch goes to Japan. Japanese political control of Korea and southern Manchuria and the spirit of all her military and economic advances are in harmony with these figures.

Both the agricultural production and the agricultural potentialities of West Siberia are so great, and the capacity of the railroads is so small, that a short and cheap route to the sea and the world's markets has been a constant prepossession. But the Kara Sea, a great ice reservoir, is only navigable for two months, at the most, each year. In the period 1874–1905, 118 ships sought to make the passage via Kara Sea to Ob-Irtish outlets on the Arctic coast, and of these but 86 reached their destination. The Ob estuary is forbidding, for ice lingers in it so late that the river is free from ice but 146 days of the year at Obdorsk. The bar at the mouth has but three-fourths of a meter of water. Projects have been planned to construct railroads from the Ob to Barents Sea in order to avoid these difficulties.

The cotton and dried fruits of Turkestan are in contrast to the agricultural products of the temperate region farther north, and there thus exists in West Siberia a basis of exchange; but it is not nearly enough to make the region self-sufficient, so that West Siberia for both export and import must depend upon European Russia.

Set between the East and West is Middle Siberia, with a population scarcely greater than one-third that of West Siberia, whose products, namely, those of the Far East, particularly from China, find their way across West Siberia but do not stop there in any great quantity. Long continuous stretches of territory may be developed in West Siberia; in Middle and East Siberia there is a greater extent of upland and mountain, with deep and crooked valleys and greater remoteness and isolation in consequence, so that nuclei of settlement are scattered about in a non-continuous pattern.

Pohle has included in his paper a wealth of statistical material, recent and accurate, which furnishes the fundamental basis of his analysis of the life and relationships of the different parts of Siberia. He deals with the population increase of the different regions in late periods; and, though these periods are not always closely comparable owing to the unequal dates for which statistics are available, they yet furnish a reasonable basis for comparative growth and prosperity.

The northern border of the Siberian realm comes in for a certain amount of detailed treatment of high geographical interest. Whereas on the west of the Urals, between the Arctic coast and the Black Earth district, there are fourteen degrees of latitude, the belt between Cape Chelyuskin and the Black Earth district is twenty-four degrees wide. There appears to be a rather close correspondence between the trend of the coast and the southern border of the tundra. The map opposite page 1 shows this unmistakably until we reach the Stanovoy Mountains, where Arctic influences in the lee of the continent push the southern border of the tundra southward to the base of the Kamchatka Peninsula. The broad belt of the *taiga* reinforces the difficulties of distance from the sea and both *taiga* and tundra have only scattered settlements of natives or island-like settlements of gold diggers.

The author has something to say of the reindeer problem. He finds all parts of the tundra

accessible, and extensions of land supporting reindeer are found in the mountains south of the tundra belt in the midst of the *taiga*, where the forest cover is broken by uplifts that bear appropriate vegetation. Supplementing the reindeer is the chase, and wide spaces foster such activities. Goods such as bread, flour, tea, sugar, etc., which neither the forest nor the tundra can yield, are imported. Hunting and fishing are supplementary sources of food.

There are abundant statistics of production and area in the three chief sections of Siberia, and these complete the picture of the relations of man to his environment in this remote and widely extended land where the conditions of life are so uniform over broad stretches and where the frontier is not a narrow belt but a broad one half a continent wide.

## Principles of Regional Geography Applied to Russian Turkestan

Arved Schultz. **Die natürlichen Landschaften von Russisch-Turkestan.** ix and 66 pp.; maps. (Abhandlungen aus dem Gebiet der Auslandskunde, Vol. 2.) L. Friederichsen & Co., Hamburg, 1920. 11 x 8 inches.

It is the introduction to this paper that is of chief significance. In it the author briefly reviews the principal articles dealing with the question of natural regions from Herbertson (1905) to Gradmann (1916). He then analyzes the relation between general and special regional studies and gives thirteen categories of structural facts necessary in a study of the natural regions of a country: orography, climate, genetic morphology, hydrography, dynamic morphology, agriculture, plant geography, animal geography, genetic anthropography, ethnography, demography, economics, and transportation. It is, of course, not assumed that these subjects will be developed with that fullness of detail that the specialist in these various fields would demand, nor that all of them are necessarily applicable to a given region; but rather that they should be developed where applicable in their geographical aspects. Had he stopped here the author would have laid himself open to grave criticism as being the newest addition to the long line of special pleaders who believe that they can trace geographical influences through the affairs of men without taking into account the multitude of ways in which man's course is directed independently of geographical circumstances and conditions. Such dependence upon the formula of geographical control or influence would not be objectionable if the result were labeled "suggestions." When the result is put forward as proof the effect is disastrous. For man does not react to nature alone; he reacts to life itself—to the past of his kind, to emotion, to desire, to ambition.

Each problem of man arises from a complex of forces, of which some may be geographical. These must be studied in their relationships or they have no meaning. Well does Schultz say that the ultimate object of geography is the ecology of man and his culture; and that it is a mistake to limit the study of natural regions to their physical geography without consideration of cultural regions in their anthropogeographical relationships.

The distinction made between the nucleal and marginal portions of a natural region is particularly suggestive. Often the marginal belt may be broad and marked by transitions from neighboring regions. It is the nucleus that has the distinctive features of the region. Its characterization is especially significant. Important also are the differences of environmental detail here and there, which may indeed have exceptional influence in the distribution of man and may significantly modify his life within the general framework of a region. Without attention to environmental details the whole regional treatment may prove weak or break down altogether.

After the author has laid down his principles of regional study he applies them to Russian Turkestan. The result has many praiseworthy features, especially from the pedagogical standpoint. Geographical data are conveniently and closely organized. The relation between the author's theory of regional treatment and his practice is, however, not always clear. In the chapter entitled "Bodenkundliche Gliederung von Turkestan" there does not appear to be any established connection between the physical characters of the soil and the distribution of people. Other chapters on the physical data are to less degree disconnected with the main theme, yet all suffer from a certain detached quality as if they were separate essays on as many different subjects. Doubtless they broaden the reader's background and hence have a certain value. The paper must be judged principally by Chapter 14, entitled "Die Landschaften Turkestans." Here we have the various regions grouped according to their physical character. But one looks in vain for penetrating reasons for the classification adopted. The chapter may be characterized as containing a series of dicta put into technical

terms. For example on page 62 there is a discussion of the nucleal area of a region and the character of the border zone, but the whole matter is expressed in physical terms. The author runs through his list of categories, that is to say his outline, and tells us why he puts things together. But in hardly a single one of the 10 principal subdivisions or the 30 minor subdivisions have we a view of the life of the region in its physical setting. The lack of collation of geographical data is a serious disappointment after the excellent introduction. Nor is the reader greatly helped by a series of 15 maps which illustrate the paper and which give the plant and animal geography, the physical features, etc. They present appropriate and interesting data, but their relationships are left to the reader. In short, the whole paper is less a regional treatment than an essay on the material for a regional geography of Russian Turkestan. Three of the maps, those dealing with the ethnography, the distribution of population, and the agricultural divisions, are taken from the Atlas of Siberian Russia, published in 1914 by the colonization bureau of the Russian Government.

## On Formosan Forests

Ryozō Kanehira. **Anatomical Characters and Identification of Formosan Woods with Critical Remarks from the Climatic Point of View.** 2 and 317 pp.; diagr., ills., bibliogr., index. Bureau of Productive Industries, Taihoku, Formosa, 1921. 10 x 7½ inches.

This excellent work is divided into four chapters. Chapter 1 deals with the vegetational character of the ligneous flora of Formosa. Chapter 2 includes the histology of the secondary wood of 386 species together with short notes on external and chemical character such as color, density, flavone content, etc. Chapter 3 is an artificial key for the identification of Formosan woods. Chapter 4 contains a summary and critical remarks from a climatic standpoint. As a basis for the latter, study was made of 160 species of Philippine woods and 181 species from Japan proper.

The island of Formosa lies between latitude 25° 30′ and 21° 40′ N. and longitude 119° and 122° 10′ E. The area is 13,890 square miles, of which about 80 per cent (7,024,000 acres) is forested. Wild peoples inhabit about two-thirds of the forest area.

Topographically the island may be divided into two parts, the mountain district and the plains district, the former being occupied by the central range of mountains which for the most part belong to the Paleozoic formation. This range extends north and south, and many of the highest peaks are more than 12,000 feet above sea level. The existence of these mountains in a tropical and subtropical region is conducive to a very rich forest flora.

The number of known indigenous plants comprises 169 families, 1,185 genera, 3,608 species, and 78 varieties. A study of the geographical distribution of the woody plants of the island shows for 998 elements the following results: Endemic, 36 per cent; China, 18 per cent; Japan, 14 per cent; India, 13 per cent; Malaya, 10 per cent; Philippines, 5 per cent; Australia, 3 per cent; Africa, 1 per cent. There is much evidence that the island was connected with the mainland of Asia until a comparatively recent period.

Three forest types are recognized: (1) Evergreen broadleaf forest, about 2,274,000 acres; (2) mixed broadleaf trees and conifers, about 424,000 acres; (3) pure coniferous forest, approximately 585,000 acres. The coniferous forests are first in economic importance because of the more serviceable timbers they produce. The trees of highest economic value belong to three families, namely, Coniferae, Cupuliferae, and Laurineae. Only a small part of the very rich and extensive forest area is subjected to any form of utilization, partly because of the savage inhabitants but more especially because the whole region is very difficult of access on account of the steepness of the mountains.

From the climatic point of view the Formosan flora may be divided into four zones, namely, tropic, warm, temperate, and frigid. The tropic zone is confined to areas below 1,000 feet altitude and has two distinct types of vegetation, that of the plains region and that of the tidal forests. The latter comprises two subtypes, the mangrove and the beach forest. *Ficus* is the representative tree of the plains district as mangroves are of the coast swamps. Most of the trees of the beach forest are of Indo-Malayan origin, owing their distribution probably to the sea currents. The vegetation of the plains region is highly variable since the land is mostly in cultivation.

The warm zone is mostly occupied by evergreen broadleaf trees, with very few scattered conifers, and comprises a large proportion of the forest. The principal families are Laurineae, Cupuliferae, Urticaceae, Euphorbiaceae, Leguminosae, and Ternstroemiaceae.

The principal trees of the temperate zone are the conifers *Chamaecyparis obtusa* and *C. formosensis*, with certain broadleaf trees often in mixture. Higher up *Pinus Armandi* appears in the sunny places, and large specimens of *Tsuga formosana* are found on the cliffs.

The vegetation of the frigid zone is very simple, with pure stands of *Abies Kawakamii* predominating. Higher up the mountains are grassy slopes with some low shrubs.

The author discusses the local occurrence of trees and shows that, despite the smallness of the island, there are many plants which have only a very local distribution. He also compares the ligneous flora of Formosa with that of Japan and the Philippine Islands. Gymnosperms are represented in Formosa by 14 genera, in Japan by 17, and in the Philippines by only 7. Pine trees are very common in Japan but occur only scatteringly in Formosa. In Japan the most valuable and widely distributed coniferous trees are "hinoki" (*Chamaecyparis obtusa*) and "sugi" (*Cryptomeria japonica*), while in Formosa "hinoki" and "benihi" (*Chamaecyparis formosensis*) are the predominant conifers. "Without 'hinoki,' in Formosa, the utilization of the forest would have been at a very great disadvantage."

As to the dicotyledonous trees, the Philippine flora has a strong representation of the higher orders, the Japanese of the lower; while the Formosan is intermediate. Dipterocarps, the predominant trees of tropical Asia and the most important commercially in the Philippines, have no representatives in Formosa. In striking contrast to the largely deciduous forests of Japan there is very little tropical deciduous high forest in Formosa. "This is due to the climate which has no prolonged dry season; and it is a rather interesting point that in the southern parts of Koshun, where the dry season comes in winter, there are [some] deciduous trees."

SAMUEL J. RECORD

## THE RAINFALL MAP OF SOUTHERN AFRICA

J. R. SUTTON. **A Contribution to the Study of the Rainfall Map of South Africa.** Maps, bibliogr. *Trans. Royal Soc. of South Africa*, Vol. 9, 1921, Part 4, pp. 367–414. Cape Town.

The rainfall of South Africa has been studied and charted by several authorities, among them J. G. Gamble, Karl Dove, Raulin, Tripp, Buchan, and others. Buchan's maps are reproduced in Bartholomew's "Atlas of Meteorology," 1899. Recently J. R. Sutton, of Kimberley, who has contributed several valuable studies on various meteorological phenomena of South Africa, especially of Kimberley, has also given attention to the rainfall. Mr. Sutton's first paper, entitled "An Introduction to the Study of South African Rainfall" (published in *Trans. Phil. Soc. of South Africa*, May, 1904) dealt with 160 stations having records of long periods.

In his present contribution Mr. Sutton has used the monthly and annual rainfall values for 567 stations in South and East Africa. Hence he is able to give us a much more complete and accurate cartographic presentation, as well as descriptive and explanatory account, than has heretofore been possible. Most of the computation of the averages was done by the author himself. The aim has been to use all existing records of ten years or more. A good many cover over twenty years, and two (Rietfontein and Kimberley) cover 40 years. Records of less than 10 years have been used for areas not well supplied with gauges, "since it has seemed better to get an approximation to the average rainfall at such places than to ignore them altogether." In only one case has any interpolation been attempted. There is no statement of any reduction of the records to a uniform period. The stations are grouped in 30 sections, 17 of these being essentially those used by the late Meteorological Commission of Cape Colony. Descriptive and explanatory notes are given of each section. The area included extends as far north as to cover southern Angola on the west of the continent and the whole of Portuguese East Africa on the east.

There are thirteen maps (9 by 12 inches) showing the isohyetal lines for the twelve months and for the year, drawn on a base on which the main features of the relief are indicated. One feature of special interest stands out, and that is the few conspicuous instances in which there seems to be any marked influence of the mountains upon rainfall. Topographic effects are seen along the terraces facing the Atlantic, in a few other cases, and, most strikingly, in the Zoutpansbergen of northern Transvaal. The latter are the only obstacle to the unbroken course of the tropical dry belt across the continent. The explanation given by Mr. Sutton is that most South African rainfall comes in thunderstorms,

"whose origins and tracks are largely independent of the geographical contours, and whose clouds are higher than most of the mountains." These conditions are obviously unlike those in regions where mountains are great breeding places for thunderstorms. The monthly maps show that the control of the rainfall is less dependent upon the topography than upon the seasonal migrations of the main rainfall belt to and from the equator. The winter rains of the southwest advance as the summer rains retreat, and vice versa. Similarly also the southern and southeastern coastal belt rains advance and retreat seasonally. Occasionally the winter rains of the southwest, and the southern coastal belt rains also, advance inland as far as Kimberley and Bloemfontein.

There are special brief discussions of the mean hourly variation of rainfall at Kenilworth (Kimberley); of the average number of rainy days; the greatest rainfall in one year; and the heaviest rainfall in 24 hours, for each section. A note on South African hailstorms brings out some interesting facts. Several cases of remarkably large hailstones are recorded. At Maritzburg in April, 1874, hailstones were "too big to go into a breakfast cup" (4½ by 3½ inches in diameter; weight 1½ pounds). In another hailstorm in December, 1915, one stone measured 4 by 4 by 4½ inches. Numerous hailstones fell which weighed over three-quarters of a pound. Many sheep were killed. One hailstone went through a roof of corrugated iron, leaving a hole about 3 inches in diameter. Two observers reported that the majority of the hailstones were the size of tennis balls.

A bibliography is appended which will prove useful in any general or historical study of the subject.

R. De C. Ward

## Rural Life in New York State

E. O. Fippin. **Rural New York.** xv and 381 pp.; maps, diagrs., ills., index. (Rural State and Province Series, edit. by L. H. Bailey.) The Macmillan Co., New York, 1921. 7 x 5 inches.

Agriculture, the oldest of industries, is, in the minds of many of those who practice it and of more who depend upon it for the necessities of life, a little-understood vocation just to be taken for granted, like gravity. Both producers and consumers need enlightenment as to the factors on which agriculture depends.

The farmer needs an understanding, not merely of the practices and methods of his community, but of the whole agricultural region in which he lives. He needs further to appreciate the significance to him of industrial developments in other fields and how these change market demands. He must have an agricultural perspective on the country and perhaps the world; he must know when conservatism in agricultural practices is sane and when foolish. He must know agriculture as it is, however untenable this new knowledge may make the agricultural faith he may have inherited from the past.

The consumer, whether in home or factory, needs to appreciate that modern farming is a business and, like other lines of business, is subject to economic laws and principles. As a matter of useful information and for his own guidance he should know the reason of the distribution of agricultural areas, the reason for general farming in the northeastern states, why land apparently going to waste may mean agricultural efficiency, why farmers cannot change crops as readily as a machine shop can change patterns, what must be produced near to the consuming area, why the marketing of farm products is often costly, and many other matters that the up-to-date farmer has to understand and appraise in planning and carrying on his business.

Fippin's "Rural New York," the first of a series of volumes on the several states of the country, is a book for urban and rural people. The reader—and he can hardly fail to be an interested reader—will find that this little volume gives a real understanding of rural New York and throws much light upon rural life and conditions in the other northeastern states where mixed, or general, farming predominates.

The volume is well ordered, clearly written, and, barring many illustrative maps that are too minute for usefulness, eminently successful. It should be widely read, for it is a distinct contribution to our literature on rural life. No one can fail to gain from it a better appreciation of farming as it is and a keener sympathy for the farmer, who must often labor with only a partial understanding of the conditions that influence his success. No would-be back-to-the-lander, particularly in New York state, should fail to study this volume carefully before he "obeys that impulse."

Richard Elwood Dodge

## A Guide to the Mohave Desert

David G. Thompson. **Routes to Desert Watering Places in the Mohave Desert Region, California.** vii, 4, and 87–269 pp.; maps, ills., index. *U. S. Geol. Survey Water-Supply Paper 490-B.* Washington, D. C., 1921.

A widely-read periodical recently stated in an editoral note that "The Great American Desert" is no longer on the map and that tourists in automobiles now safely cross districts where pioneers years ago lost their lives struggling in the sands. Both statements are in a measure true; but the great desert is still there, and travelers sometimes find a trip across it dangerous in spite of the comparative ease of automobile travel. Competent testimony on both these points is found in an important paper, lately issued by the U. S. Geological Survey. The preface by O. E. Meinzer, a widely experienced observer, states:—"The desert region of the United States forms a great triangle whose base, 800 miles long, is the Mexican border from the Peninsular Mountains, in southern California, to the mouth of Pecos River, in Texas, and whose apex is in north-central Oregon. . . . It covers about 500,000 square miles or very nearly one-sixth of the area of the United States. This region is by no means devoid of natural resources or human activity. It contains prosperous cities, fertile agricultural districts, forest-clad mountains, a large aggregate number of watering places, many rich mines, and an unknown wealth of mineral deposits. But the localities that have water supplies are widely separated oases in a vast expanse of silent, changeless, unproductive desert whose most impressive feature is its great distances and whose chief evidences of human occupation are the long, long roads that lead from one watering place to another. In the future existing oases will be enlarged, many new ones will be created, and the mineral and agricultural product of the region will be greatly increased. But in spite of all that man can do this large region will remain essentially a desert."

As to the disappearance of the name "Great American Desert" from our maps, that is natural enough; such a name is unpopular because it is unattractive to settlers; no western territory or state would relish being represented in a region so called. Even the word "oasis," although truthfully and courageously used by Meinzer as quoted above, is commonly replaced by "settlement," which carries with it no suggestion of a barren desert around it. But in the interest of candor and accuracy, the plain facts deserve frank statement. The most important among them are, on the one hand, the vast extent of the desert region and, on the other the great value of its oases and mineral deposits. The text of the above-named paper by David G. Thompson, although chiefly devoted to accounts of roads and watering places in the Mohave desert district to which it is limited, contains also general and useful information by which popular misapprehensions may be corrected. The Mohave district, including Death Valley, was selected for description because its 60,000 square miles in southeastern California and southwestern Arizona include "the driest, hottest, and least explored part of the desert region." Its three type forms, isolated mountains, piedmont alluvial slopes, and basin-center *playas*, are briefly characterized; many mountain ranges and more than fifty *playas*, large and small, are shown on the accompanying maps. The erroneous idea that a desert is completely devoid of plant and animal life is corrected; an observant traveler may see a considerable variety of both. Mineral products have been large; from 1894 to 1918 San Bernardino county, or that part of the Mohave desert which occupies southeastern California, yielded $56,000,000, largely in gold and silver; but these products are inconstant; they rise and fall rapidly; and the mining towns, being dependant entirely on more fertile districts for their supplies, are as a rule short-lived: thus Calico, which is said to have had a population of 5,000 in the late eighties, has had only three or four inhabitants in recent years. It is otherwise with the irrigable areas; for, although they are not of great extent in this driest and hottest part of the vast desert region, they are likely to prove permanent assets to the nation.

Valuable information is given under "Suggestions for Desert Travel." It is remarked that "until recent years the traveler in the desert used burros or horses and wagons as his means of transportation. Since the advent of the automobile the use of horses has nearly ceased. With this change travel in the desert has become less difficult and has therefore increased very much. . . It must not be supposed, however, that travel in the desert with an automobile means travel without danger. In some respects the danger has increased. It is much easier to get a long distance from known watering places with an automobile than with a team, and a breakdown at a remote point may be very serious. Since automobiles

have come into use there is also much more travel by persons not familiar with the region through which they are going. Moreover, with automobiles numerous difficulties may arise that were not encountered by those traveling with horses and wagons. . . . No one should go in an automobile far from a town who is not sufficiently familiar with the mechanism of the machine to make necessary adjustment of the carburetor and spark plugs and other minor repairs or who cannot make repairs to tires. This seemingly needless statement is made because there are many persons who know only how to manipulate the throttle and brakes of their cars. The writer has come upon such persons stalled on main roads of the desert, and they would have been in a bad plight on less traveled roads."

Inasmuch as "such persons" appear to exist in large numbers, and as the desert actually exists in large area, there seems to be about as much danger when they attempt to cross it as there was in the early years of pioneer travel.

W. M. DAVIS

## HEALTH AS A FACTOR IN HUMAN HISTORY

R. M. BINDER. **Health and Social Progress.** xi and 295 pp.; index. Prentice-Hall, Inc., New York, 1920. 7½ x 5 inches.

One of the hopeful signs of the future is the growing recognition that man is biologically an animal. Books like Professor Binder's "Health and Social Progress" are helping the world to see this because they emphasize the intimate relations among three great factors, first the biological inheritance with which a man is endowed; second the physical health and energy with which he uses his endowments; and third, the external conditions such as education, religion, and government which determine the direction of his energies and the degree of wisdom with which they are used. Professor Binder stresses health, which is today perhaps the most neglected of these three factors. The thesis of his interesting book is that "No people has ever succeeded in rising above the level of savages unless it possessed at least fair health; where either economic or climatic conditions prevented health, no civilization could arise; and where it had arisen it was doomed whenever new conditions arose which undermined health." His description of the perfect poise and vigor of the man whose health is so good that he absolutely forgets his body is fine. So, too, is his discussion of many indirect ways in which even a slight departure from perfect health leads to discontent, poor work, poor temper, bad judgment, and general inefficiency.

Even more interesting is the author's summary of what has actually been accomplished by measures for the eradication of hookworm disease, pellagra, and other ailments. It is an extraordinarily significant fact that "about 940,000,000 out of the 1,600,000,000 people on the globe live in countries where hookworm disease is prevalent," and that in many of these countries the percentage of infection ranges anywhere from twenty to ninety per cent. When this is put with such facts as the following it shows that we are here face to face with one of the greatest of all the means of progress during the next century. "In Costa Rica sixty-six laborers before being treated for hookworm disease normally cultivated 563 acres of coffee monthly. After being treated for hookworm disease they cultivated 750 acres, resulting in a net monthly increase in wages of 27 per cent, after allowing for a 15 per cent reduction in unit pay. Moreover, in India, Clayton Lane reports that the amount of work increased 20 per cent on one estate and 50 per cent on another, and on both was of better quality than before the laborers were treated; while reports from British Guiana indicate that the efficiency of the laborers employed by one company increased from 25 to 50 per cent after hookworm measures were put into operation." Moreover, as Binder shows repeatedly, the deadening effect of poor health on man's capacity and happiness is a prime factor not only in backward regions, but even in our own country among people of high intelligence.

It is to be regretted that a book which contains so much that is good is marred by minor inaccuracies and overstatements and by an unusually strong tendency toward broad generalization with little or no visible basis of fact. For example, Sweden is stated to have the lowest death rate and longest life of all countries, although the *Annuaire International de Statistique* gives the death rates per thousand inhabitants for 1908–1913 as follows: Denmark 13.2, Norway 13.6, Netherlands 13.9, and Sweden 14.0; while England and Wales stands at 14.1, and New Zealand and Australia stand much below 14.0. Again olive oil and silk are given a prominent place among the "tropical" imports into the United States. Worse than these minor errors is the fact that in his enthusiasm for his subject the author minimizes the importance of everything else. For instance, he attributes ill health almost uni-

versally to parasites and food and makes an elaborate attempt to show that inheritance and climate are of minor importance. With this goes an unfortunate tendency to start with a thesis and "prove" it instead of starting with the facts and seeing what they prove.

Worst of all the author makes categorical statements which neither he nor any one else has proved: "The foods produced in the north could produce in combination with other favorable factors prevailing there, a strong physique and a strong brain, but not a fine nervous system and brain. The digestive organs were too much overburdened, for instance, with the assimilation of starch in northern latitudes, and the nerve fiber could not become as fine as that which was nourished on sugar." All this and much more is stated without a single qualification, as if it were a well demonstrated geographical truth, whereas it is merely an interesting hypothesis which is worth investigation. Nevertheless, Professor Binder's book well deserves reading. It stresses a great truth which geographers, economists, and historians must some day recognize, namely that the health of a people is at least as important as the material wealth of their country.

ELLSWORTH HUNTINGTON

## A TEXTBOOK OF PRINCIPLES OF HUMAN GEOGRAPHY

ELLSWORTH HUNTINGTON AND S. W. CUSHING. **Principles of Human Geography.** xiv and 430 pp.; maps, diagrs., ills., index. John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London, 1920. $3.50. 9 x 6 inches.

This is a textbook designed "to set forth the great principles of geography in its human aspects," to make clear "the relation of the physiographic environment to man's activities." In general, the arrangement of material and the allotment of space are commendable. Two-thirds of the book is devoted chiefly to the direct responses of man to the great elements of the physical environment—to location, land forms, water bodies, soil and minerals, and climate. The last third deals for the most part with man and his work in the leading climatic realms but includes brief chapters on the world's diet, man's changing surroundings, and the elements of political geography. The book is noteworthy for its many crisp, picturesque passages, some of which are written in a truly fascinating manner. Such discussions as that of the Kirghiz nomads (pp. 12–21) will help to arouse in students a lively interest in human geography. Many of the questions and problems at the ends of the chapters are adapted to promote clear and original thinking on the part of the student.

In spite of its good qualities the book, in the judgment of the reviewer, fails in its purpose and, except perhaps when used with caution by well-trained teachers, cannot give the "solid grounding" in human relationships which it was intended to provide.

1. The treatment is not consistently adapted to students of a given degree of maturity but varies from that appropriate in the elementary school to that suitable for the later years of the university. Pedagogically this is a serious defect. Such attempts to aid the young reader as that made on page 168 in indicating parenthetically the correct pronunciation of the word "prospecting" will prove amusing to more mature students.

2. In avoiding a technical treatment of the physical environment the authors have gone so far in some cases that the student doubtless will not get a clear understanding of the *effect of the environment on life*. The authors' viewpoint is reflected in the statement that "for practical purposes it makes relatively little difference how a plain or mountain originates" (p. 81). But it is important, for example, that the student shall understand the *characteristics* of delta plains, flood plains, lake plains, glacial plains, etc. (largely ignored in this book), if there is to be more than a superficial understanding of life responses in such areas. Certainly it would be unfortunate if the student shared the opinion of the authors that "under similar conditions of location, soil, and climate, plains of all kinds are much alike in being level places where the soil is deep" (p. 81); for most plains are not level, and in some of them the soil is not deep. Similarly the student would understand better the *effects* of climate if more were said concerning the *characteristics* of climates of different types.

3. A textbook should distinguish sharply between fact and theory; failure to do so tends to develop the cocksure, half-baked opinions frequently held by college sophomores. This is not done in the case of the tetrahedral theory (p. 51 *et seq.*) and of Dr. Huntington's theories concerning climatic changes and their human relations (pp. 370–374).

4. Although most of the illustrations are well chosen, some are not well placed or are not made to supplement the text effectively. Thus a map showing the migration of the cotton boll weevil appears on page 306 but is not referred to until pages 360 and 375 are

reached. Some of the maps, unfortunately, are open to much more serious criticism. For example, Figure 53 (p. 178) is intended to show the distribution of the more important deposits of iron ore but omits those of Brazil, Newfoundland, and Cuba. Figure 61 (p. 191) is designed to show the distribution of coal production but indicates no production for China and India, both of which furnished more in the last year of normal production (1913) than Canada, the output of which is shown. No dates are indicated for any of the production maps—an unfortunate omission since production varies from year to year. The map showing the "principal railways of South America" (Fig. 29B, p. 71) fails to indicate some 700 miles of the longitudinal railway of Chile, which is one of the greater railway facts of the continent.

5. The great need of promoting the more efficient utilization of natural resources is recognized, but many of the statements which relate to their conservation seem to reflect only a slight acquaintance with the problems involved. The statement concerning the value of crop rotation (pp. 159–160), by implication complete, ignores its value in reducing the ravages of insects, in helping to overcome plant sickness (soil sickness), and in helping to prevent reduced yields through the influence of toxic bodies. The "danger" that the German reserves of potash "would prove insufficient" is assigned (p. 164) as a chief consideration which led the United States government to undertake a search for new sources of supply. Since the deposits near Stassfurt contain 2,000,000,000 tons of potash, enough to supply the world for some 2,000 years at the present rate of consumption, this "danger" manifestly was not imminent; and Congress, unaccustomed to look 2,000 years ahead, of course was moved by other considerations. In noting the sources of phosphates (pp. 163-164), no mention is made of the phosphate rock deposits of Utah, Idaho, Wyoming, and Montana—the largest known deposits in the world. Similarly in considering (pp. 199-200) what we shall do in the future for petroleum products or substitutes for them, no mention is made of the oil-shale deposits of Colorado, Wyoming, and Utah—the most important deposits of the kind known. In listing the varied uses of petroleum (pp. 196-197) the use of kerosene as an illuminant is not noted, although by another writer it has been aptly termed "one of the greatest of all modern agents of civilization." On page 203 the astonishing statement is made that when a satisfactory solar engine is available "we may hope at last to get rid of our coal mines." Surely Dr. Huntington has heard of the scores of products important in the arts, the industries, and medicine, that are derived from coal! The "great difficulty of the Mississippi waterway" is discussed on pages 138–139. Its channel depth of 9 feet to St. Louis apparently is considered adequate; but its lower course is winding, it is subject to seasonal floods, and especially it does not flow toward the eastern manufacturing districts and Europe. Then follows the categorical declaration that "if the Mississippi flowed from St. Louis to Baltimore or Philadelphia it would pay to spend a billion dollars instead of the hundred million already spent in improving [its] navigation." Reflection upon the fact that the Erie Barge Canal, with a channel depth of 12 feet and connecting the Great Lakes with the drowned Hudson, carries almost no freight might well cause one to hesitate about making such an unqualified declaration. The restricted use of the water power of this country (p. 149) certainly is not due to the impracticability until recently of transmitting the power any considerable distance from its source in the form of electric energy, but chiefly to unreasonable restrictions and hazards imposed by the Government prior to the passage of the Federal Water Power Act of 1920 and to the competition of power derived from coal and oil. In other words, the stagnation of water-power development continued for years after it was practicable to transmit the power long distances.

6. Various statements made in Chapter 19, on the world's diet, do not conform to the facts which have been definitely established by medical science. For example we are told (p. 350) that "a good diet must contain two main elements—carbohydrates and proteids" and that "in addition to these two main food substances certain others called vitamines, and the acids of fruits, are needed in smaller quantities." It is a well-known fact that to sustain life a diet must contain proteids, salts, and water, and that to promote growth and carry on body functions, either fats or carbohydrates are essential. That is one of these latter can replace the other for a time. A "good" diet should contain proteids, carbohydrates, fats, salts, water, and the accessory food factors—vitamines. "The Eskimo wants much fat because he needs carbohydrates to keep him warm in his far northern climate" (p. 354). But fats contain no carbohydrates. "Many equatorial people have protruding abdomens because of the great bulk of the bananas that they have to stuff down in the effort to satisfy their hunger. The bulkiness of the food in time ruins their digestion" (p. 355). It is the belief

of leading physicians that the physical deformities following such a one-sided diet are not due to the bulk of the diet, but that they are the result of nutritional diseases which are associated with improper muscle and bone development. Some grains grown in parts of the tropics "contain twice as much starch as is advisable, and when eaten exclusively render the people liable to certain diseases such as beri-beri" (p. 355). Beri-beri is due to the lack of water-soluble B vitamine in the diet and not to an excess of starch.

7. One of the greater weaknesses of the book is to be found in its many unwarranted generalizations, not a few of which clearly are due to the fact that climatic influences occupied too great a part of the authors' horizon. In earlier days immigrants from "the cool, stimulating climates of northwestern Europe" for the most part avoided the Southern States, preferring to go to the Northern States with their energizing climate (pp. 306–307). This statement inadequately explains the fact that most immigrants settled in the North, for it ignores, among other things, their unwillingness to compete with negro labor, the fact that almost all the immigrant ships ran to the northeastern seaports, and especially the greater demand for laborers by the mines, factories, and railroads of the North. Figures 111 and 112 (pp. 346 and 347) show that the foreign trade of the United States is largely with western Europe. The accompanying text, after commenting on the desirability of increasing our trade with tropical America, reads as follows: "Yet in spite of this it is far more difficult to add a billion dollars to our trade with tropical America than to add the same sum to our trade with cyclonic Europe. The reason is largely the difference in energy. The tropical people do not exert themselves to produce goods that we want, nor do they earn enough to be able to buy large quantities of the goods that we wish to sell. Hence most of the world's trade, as well as most of its other activity, centers in the cyclonic regions." Thus climate is made to explain the situation, while the historical background, differences of race, civilization, and stage of industrial development, the sources of the colonizing peoples of the western world, and the fact that the people of western Europe and of the northeastern United States have been attempting to obtain adjustment to similar environments and so have need of various things which each readily may produce for the other—to mention only a part of the other factors involved—all are ignored. Surely this is not scholarship! In passing it may be added that the sooner American geographers and business men seriously study the environment and the needs of tropical people, with a view to offering them *what they want*, instead of dwelling upon the fact that they do not buy *what we wish to sell*, the better it will be for American trade. Discussing elsewhere (p. 256) the influence of an invigorating climate on character, Dr. Huntington declares that it is much easier to speak the truth when one feels strong than when one feels weak. One wonders how this generalization was arrived at, while at the same time he congratulates himself that he lives in a climate which is said to make for strength and truthfulness. Not all the loose generalizations result from a habit of overemphasizing the influences of climate. In seeking, for example, to emphasize how Belgium became a victim to geographical location in the war, Dr. Huntington states on page 379 that "her people suffered more than did the chief parties to the quarrel" and that her material progress was set back for decades, overlooking the fact that the devastated zone lies chiefly in France, that Belgium secured large loans from her allies and was able to restore practically all of her railways and canals in two years from the time of the Armistice, that her mills are nearly or quite on a pre-war basis in spite of the loss of machinery to Germany, that her army was so small in proportion to her total population on account of the prompt overrunning of Belgium that in spite of deportations and other sources of loss her total casualties were relatively light, and that she has priority in the German indemnity payments. As a matter of fact Belgium is being reconstructed more rapidly than either France or England.

8. Numerous errors of various kinds appear to be due simply to carelessness and can be explained only by assuming that Dr. Huntington wrote much of the book in more than his usual haste. Thus we are told that Missouri is level (p. 85), that Detroit is on a lake (p. 122), that practically every river is subject to droughts and freezing (p. 134), that "the mountainous relief of Arizona causes that State to produce minerals worth more than $40,000,000 each year" (p. 167), that "in mid ocean during a storm or a battle a warship can safely [!] renew its supply of petroleum by pumping the liquid from a tender through a hose" (pp. 196–197), and that "the sun shines practically all the time in irrigated regions" (p. 325). Chile is not mentioned among the countries containing and producing much copper (p. 183), though its reserves probably exceed those of any other country except the United States and it ranked second in production in 1918; and Alaska is said to have been purchased by

the United States in part because it "is full of valuable minerals" (p. 398), though this fact [?] was not known in 1867. We are told that "some regions, . . . such as Montana, have few inhabitants because rugged mountains provide almost no place for people to live" (p. 2). Montana is an unfortunate example of the fact stated, since most of that state is not mountainous and throughout most of its history the densest population has been in its mountainous part. On page 169 one reads that "among the urban population of this country who have a small surplus for investment there are only a few [!] who have not lost money in mining ventures. They ought to know that the vast majority of mines do not pay." Presumably what Dr. Huntington meant to say is that large numbers of urban people have lost money in mining ventures. Surely it does "not pay" for scientists to make such wild statements. In not a few cases careless statements result in contradictions. For example, on page 294 Utah in its climate is said to "share many of the qualities of the Mediterranean subtropical regions," while on page 309 it is cited as an example of a "continental desert." In many cases a word of qualification would have transformed an objectionable statement into an acceptable one. Thus one cannot accept the statement (p. 289) that "in the Hawaiian Islands the absence of any duty on sugar imported into the United States has made sugar-raising the dominant industry," though of course it *helped* greatly to do so.

In view of its several good qualities it is to be hoped that the book will receive an early and thorough revision. As it stands, it is unreliable, unscientific, and displays a weak grasp of *principles*, a serious defect in a book with this title.

HARLAN H. BARROWS

## SOUTH AMERICAN CLIMATOLOGICAL LITERATURE

M. M. WELCH. **Bibliography on the Climate of South America.** 42 pp. *Monthly Weather Rev. Suppl. No. 18*, U. S. Dept. of Agriculture, 1921.

This bibliography, particularly useful in view of the scattered nature of records of South America climate, gives references to data appearing in individual works and periodical literature up to January, 1919, with a few important additions of later date. The arrangement is according to countries.

# THE GEOGRAPHICAL REVIEW

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## ESKIMO ART *


By DIAMOND JENNESS

Geological Survey of Canada


One of the most fascinating problems in ethnological study is the presence of a highly developed art among races that are in a very low stage of culture. Our paleolithic ancestors in western Europe covered the walls of their cave dwellings with lifelike paintings of the men and animals around them; and in South Africa the primitive Bushmen adorned their rock shelters with equally realistic figures in black and white. So, too, the Eskimos of the Arctic, using only flakes of flint or treasured scraps of iron, carved and engraved on bone and ivory with a skill that excited the admiration of every early explorer. This graphic art was universal among the Eskimos, extending from Alaska on the one side to Greenland on the other; it dates from prehistoric times until the present day. Every large museum in Europe and America is filled with excellent examples of it. There are not only carvings of men and animals, free and in relief, but exquisite engravings, from elaborate representations of hunting and domestic scenes down to simple geometrical patterns. It is true that there are great differences in the artistic ability of different tribes. In southern Alaska it is almost the exception to find an article of bone or ivory without decoration of some kind; even so utilitarian and commonplace an object as a bucket handle often has a row of seals or other animals carved in relief on its surface. Farther east, in Coronation Gulf, the only designs are a few incised lines, even though the beautifully polished bone needle cases and quiver handles would naturally lend themselves to more elaborate ornamentation. Sculpture reappears, however, in Hudson Bay; and in East Greenland, among one of the most barbarous and impoverished of all the Eskimo tribes, it reached almost the same high level as in Alaska. Every branch of the Eskimo race, indeed, seems to possess marked artistic ability, although in some places, owing partly to unfavorable economic conditions, the talent remained more latent than it did elsewhere.

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## Influence of European Civilization

This highly developed art of the Eskimos, far from being destroyed by contact with European civilization, as happened so often elsewhere, received a certain stimulus. Thus there are strong grounds for believing that the exceptional development of sculpture and engraving among the Alaskan Eskimos was due to contact with the Indian tribes on the northwest coast and with Russian civilization filtering in through Asia. In more recent times the settlement of Alaska by Americans has led to the creation of a regular industry in ivory work; and though most of the carving and engraving that is now being produced and sold to the outside world is of a much inferior quality, despite the use of modern tools and machinery, now and again some specimen does really attain to, if not actually surpass, the work of previous generations. The same thing has happened, although to a less degree, on the Hudson Bay side of the continent and again in Greenland.

Such unusual artistic talent among a primitive nomadic race of hunters could not fail to attract the notice of scientists, and various writers, Hoffman,[1] Boas,[2] and Thalbitzer,[3] have discussed their work in bone and ivory. One development from it, however, the pencil sketches of the Eskimos, has been altogether neglected in English-speaking countries up to the present, although one or two explorers, notably Peary and MacMillan, have published a few examples of it. The use of pencil and paper is of course quite modern, but it is merely an improvement on the old Eskimo custom of using native graphite for drawing on wood and skin. The ease and freedom of a pencil, however, has made these paper sketches a popular pastime, and amateur artists are everywhere recording their impressions and adventures in notebooks, on the margins of old magazines, and on any scrap of paper that they can find. In Danish Greenland the Eskimos have long run a printing press and published a journal devoted almost entirely to Eskimo topics and illustrated with sketches by native artists. In fact, wherever you wander, if you give a notebook and pencil to an Eskimo, whether he can write or not, he is almost certain to fill the book with drawings of men and animals, hunting scenes, and scenes of social life.

Naturally the average native, even with the pencil, is still bound by his old tradition; his drawings show the same want of perspective, the same lack of detail, and the same conventionality as his engravings and carvings. Nevertheless, under the influence of new ideas inspired by the European sketches which the Eskimos are fond of copying, an artist does occasionally rise above the general level and produce a few drawings that display real imagination and promise. It is not that he departs from the old subjects; his talent is still limited to the delineation of hunting scenes and social life

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[1] W. J. Hoffman: The Graphic Art of the Eskimos, *Rept. U. S. Natl. Museum for the Year Ending June 30, 1895*, pp. 739–968.

[2] Franz Boas: The Central Eskimo, *6th Ann. Rept. Bur. of Amer. Ethnology for 1884–85*, pp. 399–669; *idem:* Decorative Designs of Alaskan Needlecases, *Proc. U. S. Natl. Museum*, Vol. 34, Washington, D. C., 1908, pp. 321–344.

[3] William Thalbitzer: The Ammassalik Eskimo, *Meddelelser om Grønland*, Vol. 39.

as he knows it; but he develops an impressionistic idea of the scene as a totality, replete with detail and environment, together with a vague notion of perspective and a truer sense of proportion. It does not require much imagination to believe that if one of these Eskimo artists could only receive a little training he might produce something that would be worth hanging in our salons alongside the pen-and-ink sketches from Japan or the drawings of our own impressionistic schools.

## Examples of Eskimo Art from Three Different Regions

This new development in Eskimo art aroused the interest of the American Geographical Society, who gathered a number of examples of it from two well-known explorers, Mr. D. B. MacMillan and Mr. R. J. Flaherty. The drawings supplied by Mr. MacMillan were made by Kakotcheea, a nineteen-year old Eskimo of Smith Sound in northern Greenland, where Mr. MacMillan established a base for his explorations. The Smith Sound Eskimos were discovered by Sir John Ross in 1818; since that date they have been visited by many explorers and whalers, some of whom, for example Kane and Peary, remained for two or more years in their midst. Mr. Flaherty's sketches are from an altogether different region. They are the compositions of Wetalltok, an Eskimo from the Great Whale seaboard on the eastern coast of Hudson Bay. Wetalltok had been in the service of the Hudson's Bay Company for about fifteen years and beside these drawings contributed a remarkably accurate sketch map of the Belcher Islands,[4] a map that is itself one of the best examples of the cartographic skill for which the Eskimos have long been famous.

To the sketches from these two regions I have added a few that were drawn for me in the winter of 1913–1914 by an Eskimo from Cape Prince of Wales in northern Alaska. This Eskimo, named Ugiagnak, was a middle-aged man who could neither read nor write, although he had been in contact with white men all his life. The natives of northern Alaska were less advanced in graphic art than those of southern Alaska but far more so than either the Hudson Bay Eskimos or those of Smith Sound. Our three artists, then, from three different regions, are interesting on two quite distinct grounds. In the first place the identity of subject matter in all three bears witness to the remarkable uniformity of Eskimo culture despite the enormous range of territory over which it extends. In the second place, the differences in technique of the three men give us an indication of the direction which this graphic art may take among the Eskimos, if ever they are afforded the opportunity of developing it.

## Hunting Scenes

Figures 1–5 illustrate the Eskimo method of hunting the walrus. The season for walrus hunting is the late summer, when the sea is covered with

[4] Published in the *Geographical Review*, Vol. 5, 1918, p. 440.

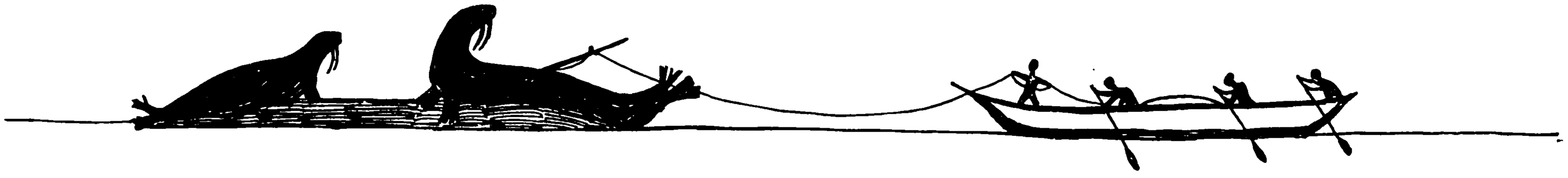

FIG. 1

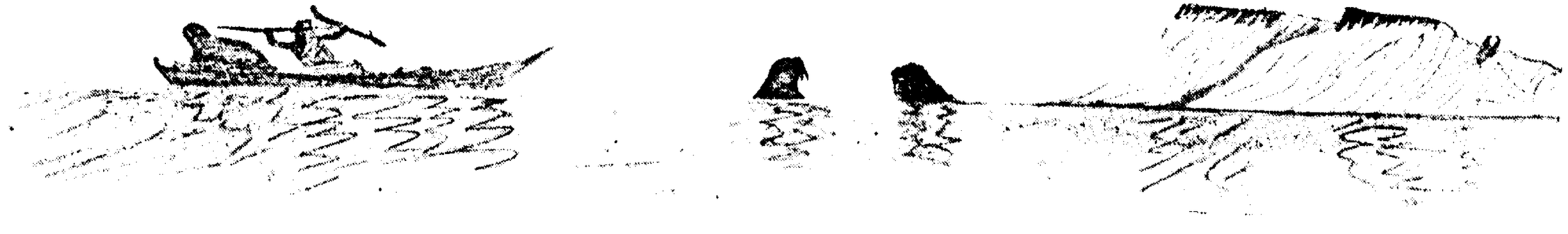

FIG. 2

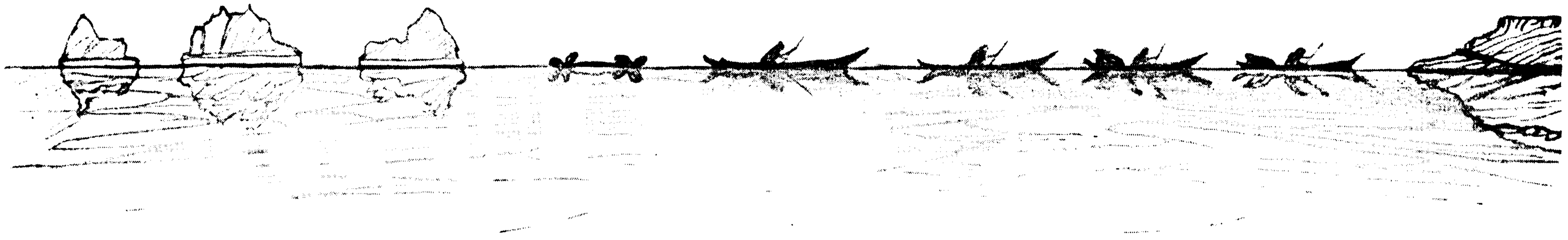

FIG. 3

FIG. 1—Harpooning walrus on the ice. By Ugiagnak, an Eskimo of northern Alaska. This and the other drawings by Ugiagnak are reproduced the size of the original, the drawings by Kakotcheea and Wetalltok are slightly reduced.

FIG. 2—Harpooning walrus in the water. By Kakotcheea, an Eskimo of Smith Sound.

FIG. 3—Kayaks towing to shore a dead walrus to which are fastened two sealskin floats to keep the body on the surface. By Kakotcheea.

loose cakes of floating ice that offer very little obstruction to navigation in small boats. The animals are harpooned either while swimming in the water (Fig. 2), or as they bask in the sunshine on some floating ice cake (Fig. 1); the *coup de grâce* is now usually given with the rifle. The carcase is then towed to shore (Figs. 3 and 4) or to the nearest ice floe and immediately cut up (Fig. 5). In Alaska, as we see from Figure 1, the hunter makes use of the large skin boat called umiak, which resembles in shape our whaleboat. Among most Eskimo tribes this is regarded as the woman's boat and is used only for transportation; the hunter's vessel is the smaller one-man kayak, as shown in Figures 2 and 3. But in Alaska the umiak is used for both whale and walrus hunting, the women serving in the latter pursuit as paddlers only. The middle paddler in Figure 1 is plainly a woman, for her hair is tied in a knot on the back of her head.

These five sketches taken together depict a scene which might occur any day in the month of August either off the northwest coast of Alaska or in Hudson Bay or on the coast of Greenland. But there are noticeable differences in the artistic value of the sketches. Figure 1, from Alaska, shows all the hardness and conventionality of the etchings on ivory which are so common in this region; it might easily have been one of these etchings transferred to paper. The artist's imagination is confined to a silhouette outline of the essential features of his subject. There are the two walruses on an ice cake, the boat, the paddlers, the harpooner, and his weapon, every one of which is absolutely essential to the interpretation of the drawing. Beyond this there is nothing, not even an indication of the sea. It is a picture story, a graphic description of an event the details of which are left to the imagination. Conventional as it is, however, it is far from being a mere pictograph; the startled attitudes of the walruses and the vigor with which the women are driving their paddles into the water give character and realism to the drawing that no mere pictograph can ever possess. Figure 4, from Hudson Bay, shows the same limitations, the same silhouette outline and lack of all atmosphere, although the artist has tried to convey a sense of the environment by adding dogs and driftwood. But in Figure 5, from the same region, a new feature is introduced, a dawning sense of perspective. The artist is not quite sure of it, and in consequence his landscape seems divorced from his main subject, the cutting up of the walrus; but he has taken a great step forward and achieved something which his ancestors, for all their skill in carving and etching, never dreamed of. The event is no longer taken out of its setting, but the two are combined into one artistic whole. He has accomplished this, too, without any loss of the old vigor; so that, crude and imperfect as his sketch undoubtedly is, it yet shows possibilities of great development. We can see a growth in Figures 2 and 3, from Smith Sound. In these the artist has a much clearer vision of the details and surroundings of his theme. His kayakers are traveling over a sea full of ripples and reflections. Figure 2 even adds a new feature, the use of shading to give depth and distance. This Smith Sound

FIG. 4

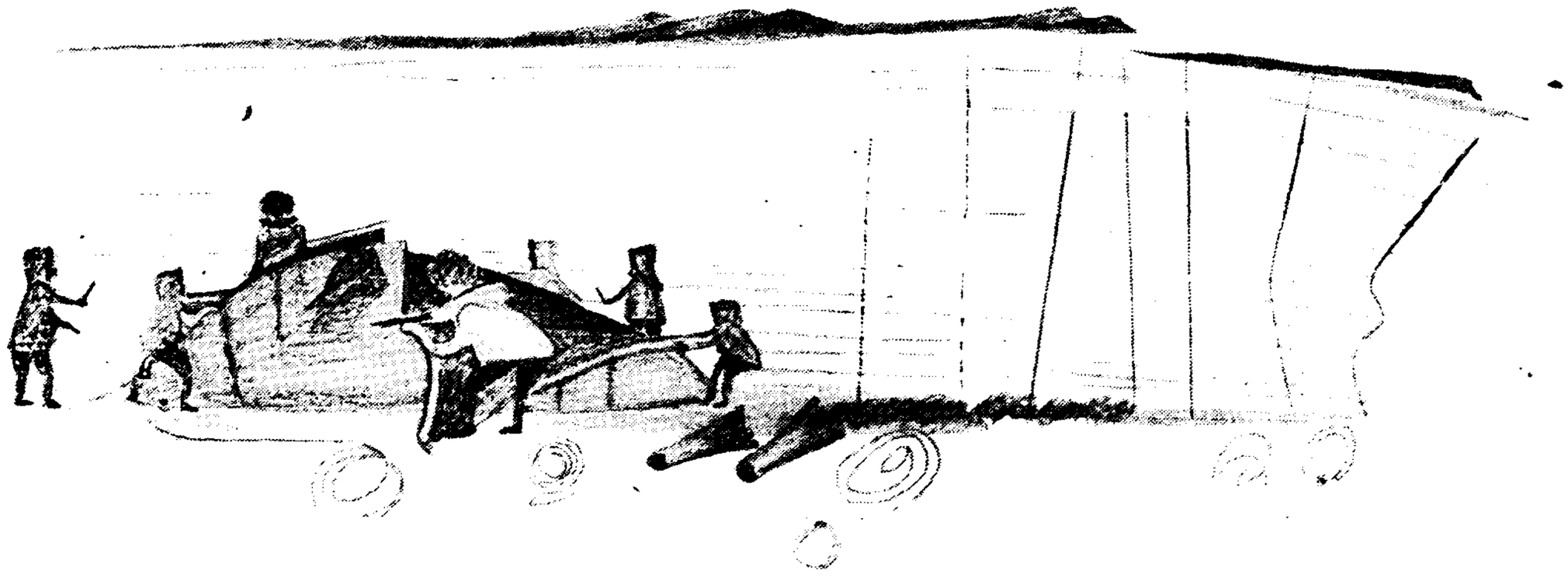

FIG. 5

FIG. 6

FIG. 7

FIG. 4—Dragging a walrus on to the beach. By Wetalltok, an Eskimo of Hudson Bay.
FIG. 5—Skinning a walrus. By Wetalltok.
FIG. 6—Hunter stalking a seal. By Ugiagnak.
FIG. 7—Going after seal (or walrus) in Kayaks. By Wetalltok.

artist has certainly traveled far beyond the Alaskan artist of Figure 1, or the engravers on bone and ivory.

Two methods of sealing, both of them common in every part of the Eskimo world, are depicted in Figures 6 and 7. In Figure 6, by the Alaskan artist, the hunter is represented as crawling stealthily over the surface of the ice towards his quarry. This is a method adopted in the spring of the year, when the seals are basking in the sunshine outside their holes. In Figure 7, by Wetalltok, the Hudson Bay Eskimo, the summer method is

FIG. 8—Hunting caribou. By Wetalltok.

FIG. 9—Caribou scenting hunters. By Kakotcheea.

represented. The seals (and walruses) are then either basking on floating ice cakes or swimming in the water around them. The hunters sometimes harpoon them from their kayaks; more often they paddle over to a small ice cake near by, draw up their kayaks, and fasten the end of the harpoon line round a hummock of ice. They then cautiously work their raft towards the seals and drive in their harpoons. The animals dive but are prevented from escaping by the line fastened to the hummock. This method of hunting has survived even the use of rifles, for in the late summer seals lose much of the blubber that gives them their buoyancy and sink as soon as they are killed.

This drawing of Wetalltok illustrates the lack of proportion that is so common in Eskimo drawings. Almost invariably, in depicting men and animals, the head is made out of scale with the rest of the figure; in the present case the seals and the ice cake are much too large. Moreover, the artist, although learning the use of perspective, has not been able to free himself from the old conventionalism. His ice cake is purely a conven-

FIG. 10

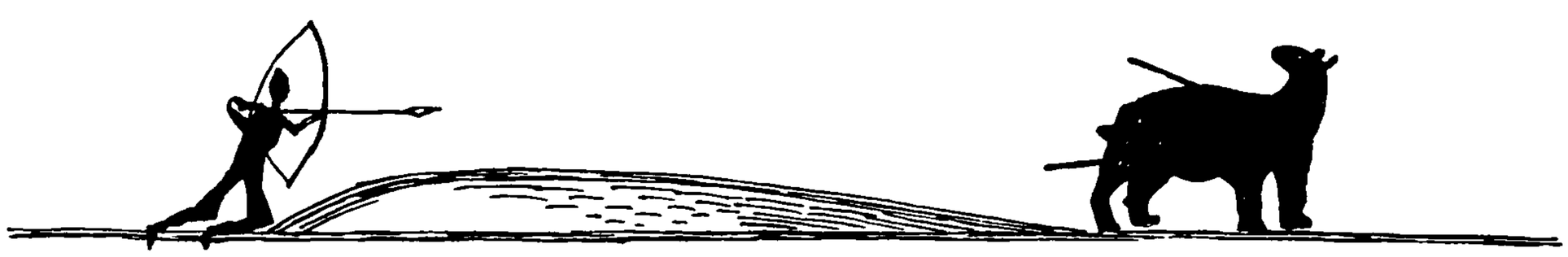

FIG. 11

FIG. 12

FIG. 10—Muskox. By Kakotcheea.

FIG. 11—Hunting the polar bear. By Ugiagnak.

FIG. 12—Closing in on a polar bear with a team of dogs. It is the custom upon sighting a bear to release the dogs in order to hold the bear at bay until the driver arrives with the rifle or lance to despatch it. By Kakotcheea.

tional one, and his seals have the traditional impersonality. His sketches of caribou in Figure 8 are far superior. They are depicted in different attitudes, all of them true to life. One is quietly grazing, another walking slowly towards it, a third lying on its side. Near the two hunters, who are armed with the old-fashioned bows and arrows, the caribou have leaped to their feet, startled; and one is running away. Over on the right is the hunters' sled with the dogs lying down in front. Excellent as the individual figures are, there is no background of any kind; they are simply an artist's studies.

Kakotcheea's sketch (Fig. 9) is quite different; it has an impressionistic touch quite new in Eskimo art. There is less variety in the attitudes of the caribou, and the horns are a little too uniform and conventional; but they are true to life, and the background is just sufficiently pronounced to give a sense of realism. It is a curious thing, indeed, that the Eskimos have always been more successful in portraying caribou than anything else; the proportions are more accurate, and the action is more vivid. No doubt it is partly due to the fact that the dependence of the Canadian and Greenland Eskimos upon the caribou for a large portion of their food supply has made

FIG. 13—Shooting geese. By Wetalltok.

them keen students of its actions and attitudes, and this has reflected itself in their art. The same reason would apply also to Alaska, although now the domesticated reindeer has taken the place of the wild caribou, which has been almost exterminated in that region. Yet this explanation alone can hardly be sufficient, otherwise we should expect the same excellence in the representations of the musk ox, which in Smith Sound is almost as important to the Eskimos as the caribou; but, as Figure 10 will illustrate, their drawings of musk oxen show much less fidelity to life. The main reason must surely be that the caribou, so universal once throughout Arctic America and the neighboring portion of Asia and so indispensable to the Eskimos for food and clothing, has been a favorite subject for representation from the very dawn of their art; whereas the musk ox with its more restricted range and lesser economic importance has a far shorter tradition behind it, and artists have not developed the same technique in its portrayal.

Figures 11 and 12 illustrate the hunting of the polar bear, which is common almost everywhere in circumpolar regions. One method is to stalk up cautiously behind ice hummocks and to shoot at close range, formerly with bow and arrow, as in Figure 11, now with the rifle. The polar bear is rather a timid animal until it is brought to bay; even then, in Eskimo estimation, it is less formidable than the Barren Ground grizzly. The method of hunting shown in Figure 12, bringing it to bay with dogs, is more certain of success. During the summer of 1915 a party of Eskimos with whom I was traveling on Victoria Island came upon a polar bear and its cub, the latter nearly full-grown, quietly swimming across a lake. They fled at sight of us; and the Eskimos, loosing the dogs, pursued them on foot. The cub was overtaken after a stiff chase of about three miles, the mother two miles farther on; and both were shot with a rifle. Before rifles came into use, however, the Eskimos used to surround the bear and stab it to death with harpoons and lances, although often one or more of their number was killed or severely wounded.

FIG. 14—Scene in a dance house. By Ugiagnak.

The last of the hunting scenes in this collection, Figure 13, is also in some ways the most remarkable. Two Eskimos clad in white overshirts, or "dickies," are shooting at a flock of geese flying overhead on their annual migration. Nowhere in Eskimo art have I seen anything approaching the excellence of these birds both in form and detail. The careful shading of the underparts alone would attest European influence. There is still a little stiffness, especially in the foremost bird, but the general effect is remarkably realistic. One can hardly credit the production of this sketch and that of Figure 7 to the same artist.

## SOCIAL SCENES

Hunting scenes and game animals are by far the commonest subjects of Eskimo art. However, we do occasionally find, even on bone and ivory, scenes of social life such as that given in Figure 14, where the artist has taken as his subject a

FIG. 15—Eskimo summer camp. By Wetalltok.

dance held inside one of the wooden houses, half buried beneath the snow, in which the Eskimos of Alaska pass the winter. The mingling of ancient and modern elements in their present-day culture comes out in the juxta-position of a skylight of seal intestines sewn together and a chimney belching forth smoke from a sheet-iron stove inside. The figures of the three drummers seated at the back of the room are instinct with vivacity and the *joie de danse*. The prancing attitude of the plume-bedecked man, and the swaying motion of the woman, well illustrate the difference in the methods of dancing of the two sexes. The last figure on the right has a religious significance. It represents a shaman or medicine man inspired by his guardian spirit, the walrus, and simulating the form of that animal by the two tusks that protrude magically from his mouth. The shaman among the Eskimos was a public functionary who gave most of his performances in the dance house. He claimed to control certain of the spirits which were believed to govern the universe, spirits of animals and of mythical beings through which he could regulate the supply of game. One of them is shown in this illustration flying unseen through the air above the dance house in search of caribou, and trailing a large stone with which to kill his enemies. Many other miracles are recorded of them, and even today the natives of Alaska firmly believe in their power, though shamanism is now dead and all the Eskimos in this region have embraced Christianity.

## SUMMER ENCAMPMENT

Summer encampments are becoming rather a popular subject for representation among the Eskimos, although comparatively rare in the old engravings. We have two such drawings in this collection, Figures 15 and 16, both by the same Hudson Bay native, Wetalltok. In the latter he has deviated from the old traditional art only in one figure, that of the man peering inside the tent, which shows a little more imagination than is usual in etchings on bone and ivory. The tents, the dogs, and the man standing are as conventional as ever. Figure 15, on the contrary, belongs to the new age that recognizes perspec-

tive and shading without as yet mastering either. It is a fair example of the ability of the average Eskimo to depict a landscape. The artist has chosen for his subject an everyday scene in summer, when the Eskimos of both Hudson Bay and Greenland pitch their tents on the seashore and with their kayaks hunt the seals in the open waters of the bays and fiords. Figure 17, by the same Eskimo, Wetalltok, shows one of their methods of traveling at this period.

## Summer and Winter Travel

As long as the Eskimos remain on the shore they can move from one sealing ground to another in their large skin boats. But summer is also the season for fishing and caribou hunting; the salmon are now migrating

Fig. 16—Eskimo tents. By Wetalltok.

Fig. 17—Eskimos traveling with packs in summer. By Wetalltok.

up the creeks and rivers to spawn, and the caribou have shed their heavy winter coats and are now covered with short-haired fur invaluable for lighter clothing. The rivers are mostly too rapid and too shoal for boats, and moreover the caribou are grazing on the open plains or on the slopes of the hills. So the Eskimo loads all the necessary equipment on his back or on the backs of his dogs and moves away inland. The man always leads on these migrations, for at any moment game may be sighted and he may have to drop his pack and go off hunting; the wife and children follow him, carrying the tent and the household utensils. An Eskimo thinks nothing of traveling 14 or 15 miles with a load of 100 pounds on his back and at the end of the day spending four or five hours in hunting. The women carry almost equal

loads, and the children in proportion to their size, while a dog's pack varies from 20 to 50 pounds. Traveling is somewhat easier at other seasons of the year, for the Eskimo can then employ his sled. In Figure 18 our Smith Sound artist has contributed a sketch that partly illustrates this method. It is an impressionistic sketch of a team of dogs dragging a sled, seen from the viewpoint of the driver. Europeans have introduced the custom of driving dogs like horses, singly or in pairs one behind the other, with the most intelligent as the leader; but in many places the Eskimos still cling to the use of a separate trace for each dog, as in the illustration. There are many inconveniences in the method, but it has one advantage; the dogs can all be released simultaneously at the sight of game by simply casting off their traces from the one toggle which holds them.

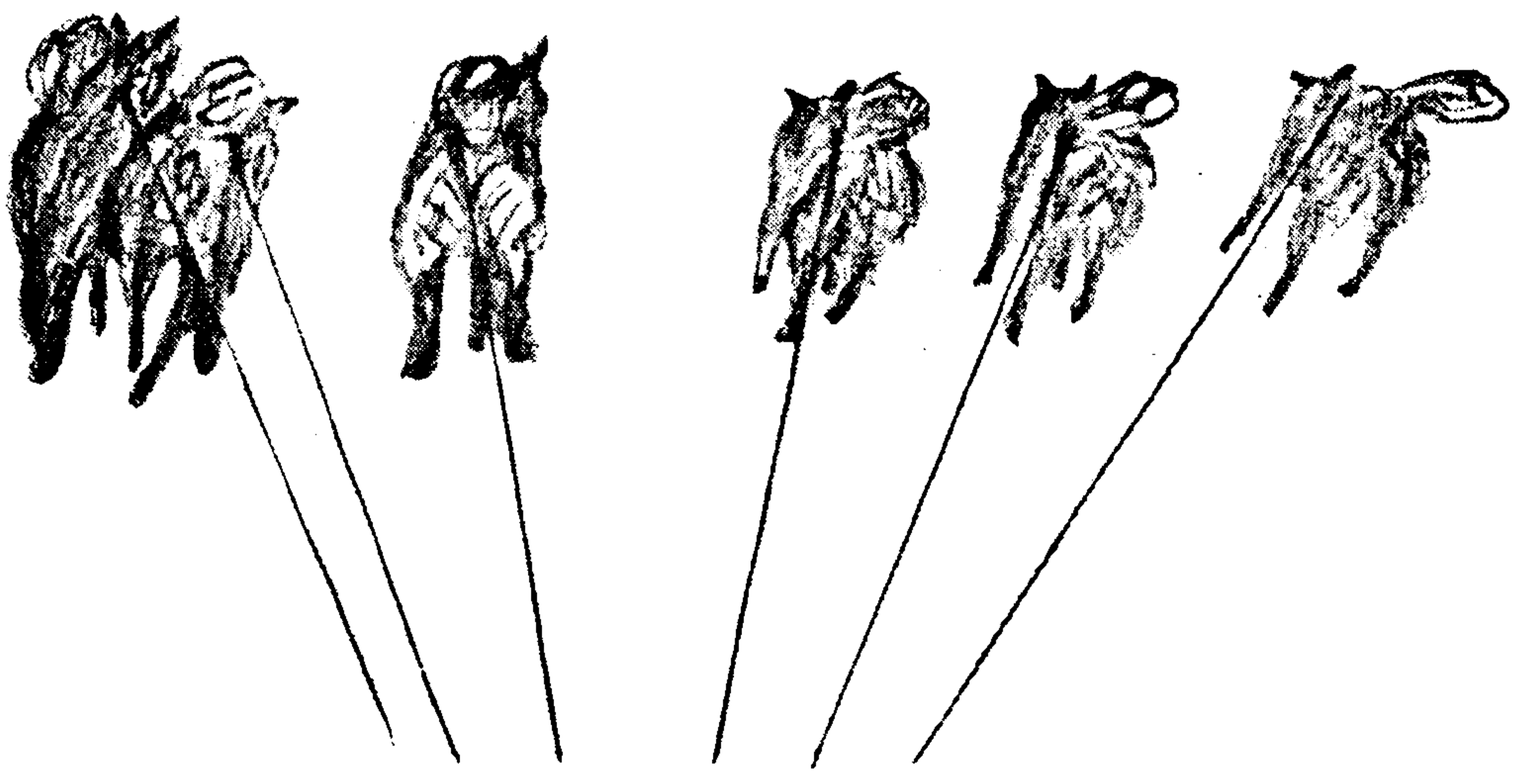

FIG. 18—Dog team viewed from sled. By Kakotcheea.

This little sketch of Kakotcheea is in some ways the most remarkable in the whole collection. In the first place the artistic conception of representing a team of dogs from behind is altogether foreign to ordinary Eskimo art. It is a photographic impression of a momentary scene, not a more or less symbolic representation of a method of traveling, as the old engravers on ivory would have made it. Again, the accuracy with which the dogs are delineated, each with some slight difference, is amazing. These panting animals tugging at their traces are totally unlike the rather lifeless, misshapen creatures of Wetalltok's creation (Figure 17). The one man might seem to have focussed an actual scene on his retina, the other merely conjured up a typical one; but I suspect that the Smith Sound native has simply copied an explorer's photograph, and that the striking individuality of his sketch is due to that source alone.

## THE DEVELOPMENT OF ESKIMO ART

From these drawings taken from three different regions, Alaska, Hudson Bay, and Smith Sound, we can gather some idea of the course along which Eskimo art has been developing during the last half-century. The Alaska drawings faithfully follow the old tradition; they might have been made

on bone or on ivory a hundred years ago. The art is a purely conventional one, everything being represented in silhouette and all details being omitted that are not absolutely essential to the interpretation of the drawings. Its greatest merit lies in the fidelity to life of the figures of men and animals and the vividness with which action is portrayed. But it is essentially a "shadow" art, where figures are merely reflected as on a screen and lack both background and depth; it assumes too readily a symbolic aspect and loses touch with reality altogether—a fate that has overtaken it in many of the ivory etchings, although our artist here has avoided it. The Hudson Bay native is in the awakening stage. He has learned to sense vaguely the crowded world of color and environment and so tends to give more detail to his drawings. Moreover, he has a growing feeling for perspective, of the relation of subject to the surrounding landscape. But the defects in proportion and the stiffness and conventionality of many of his figures mark him as being in the main a follower of the older tradition. The Smith Sound artist, on the other hand, clearly belongs to the new generation. He takes an impressionistic view of his subject, not the symbolic one of the earlier artists. In technique he has learned the principles of perspective to give distance and of shading to give depth. There is a recognition, too, of the necessity for atmosphere in a picture to help out its meaning. He has not mastered completely any one of these things; his sketches are still the productions of a mere novice in the art, but of a novice who would show promise of much higher fulfilment were it not for one great weakness—a weakness that no Eskimo artist to my knowledge has yet tried to overcome—a disregard of individuality that robs a sketch of half its character.

In conclusion one word of warning may be given. Because our Alaskan representative has adhered most closely to the old traditional art of his race, and the Smith Sound one has departed most from it, it must not be assumed that Alaskan artists as a whole are very conservative, whereas those in Smith Sound are more progressive. On the contrary I have seen sketches from both Alaska and the Mackenzie River delta that show as great an advance over the old etchings on ivory as any of the illustrations given in this article. The psychological law that "similar stimuli applied to similar subjects produce similar reactions" is really quite verified, and the type of art common to all branches of the Eskimo race is developing everywhere along the same general lines under the influence of European culture.

# THE GEOGRAPHICAL NAMES USED BY THE INDIANS OF THE PACIFIC COAST*

By T. T. WATERMAN
Museum of the American Indian, Heye Foundation

Some time ago my attention was attracted to the matter of the names given by the Indians to various places, especially in the region of the Pacific coast from Puget Sound to northern California. Within these limits I have had opportunity to talk with several hundred natives, and the total number of names obtained from them amounts to many thousands. Whenever sojourning among a tribe, I have endeavored to get every geographical name they knew, the "meaning" of it, and the exact spot on the map to which it referred, the last-named labor being facilitated by the excellent topographic maps of the U. S. Geological Survey and the charts of the U. S. Coast and Geodetic Survey.

The American public evinces a good deal of interest in this matter of Indian names. I have during late years received many a request for Indian words to be employed as the names for estates, for motor boats, for bungalows, and beach cottages. In some cases the old Indian names for places have become famous, having been attached by accident to some subsequently notable site. Where this has happened, as, for example, where a great city or a world-famous mountain boasts an Indian name, the *meaning* of the name becomes a matter of interest to thousands of people. It is a misfortune that some of the old names have become matters of dispute, owing largely to the fact that inquiries were not made prior to the passing of the Indians. Thus the meaning of "Manhattan," which is an Indian name, has given rise to a good deal of theorizing and to some conflict of authority and remains a matter of genuine uncertainty. The question of the original name of Mt. Rainier, in the state of Washington, suggests itself also in this connection. This magnificent peak towers up in the neighborhood of two rival cities, one of which has advanced the contention that the original Indian name of the peak was "Tacoma" and that the mountain name should be changed accordingly. The whole question as to whether its name was Tacoma and, if so, what the meaning of Tacoma originally was, is still a matter of lively interest to the communities involved. I have been told that a hundred thousand dollars has been expended, directly and indirectly, in the campaign to have the name changed; largely, of course, on printing and publicity. The whole matter unfortunately was entered into in a partisan and not in a disinterested spirit.

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* The expense of the journeys on which Indian place names were obtained has been borne by several institutions, among them the University of California, the University of Washington, and the Museum of the American Indian, Heye Foundation. To all of them acknowledgments are due.

In my own work such mooted points have not arisen. My purpose has been to collect as many names as possible in each area investigated, meanwhile listening to the folklore that associates itself with these old places and acquainting myself with the life of the people. By making a complete collection in each area it becomes possible to compare one tribe with another, as regards geographical usages. I now propose to say something, therefore, about the sort of names that West Coast Indians give to places and about how these tribes compare with one another and with ourselves in this respect.

## Difficulties in Determining the Origin of Place Names in General

Certain difficulties thrust themselves forward in work of this character, and it is desirable that they be explained at the outset. It is in every case possible to find exactly the spot to which a name applies. There is no limit to the accuracy possible in this respect except that of time and money. The *meaning* of Indian names, however, must remain in many cases a matter of some uncertainty. There is a probability of error which cannot be precisely measured. This is true, for that matter, as regards the place names of all countries and all peoples. Place names often come down from a hoary antiquity, and the original meaning is often not known to the latter-day people who live in the region. I can illustrate this point by asking you to imagine going out as a stranger on our streets, to learn what our place names mean. You encounter a person on Broadway who seems to have a moment's leisure and ask him the meaning of the name "Boston." One person in a thousand, perhaps, would be able to tell you that our Boston is named after the town of Boston in Lincolnshire, England. To find the derivation of the English Boston you would probably have to make reference to some such source book as "The Place-Names of England and Wales"[1] which would inform you that the name of the English town was originally St. Botolph's town. Old place names are extraordinarily likely to persist even through migrations and conquests, when the spoken language shifts and one tongue is replaced by another. Thus place names remain as puzzles and conundrums for new generations. When the Romans conquered Britain and gave their own names to places, far and wide, they found in southern Britain a big town which they honored by calling "Augusta." Their historian, Ammianus Marcellinus, speaks of setting out from Augusta which the "ancient" people called "London." He probably supposed that the name of the place would remain "Augusta" from his day until the crack of doom; but within a few years the old name London was in universal use again. Concerning the meaning, however, of this old British name there is no certainty today.

What is worse than forgotten origins are deceptive explanations. For example, Bosporus means an "ox-ford"; but whether or not this is the sig-

[1] J. B. Johnston: The Place-Names of England and Wales, London, 1915.

nificance of the English town named Oxford is questionable. This "obvious" meaning is generally disputed, many authorities believing that "ox" is a mistaken Anglo-Saxon identification with one variant of the old Celtic for "water."[2] The case of Cambridge, England, is somewhat similar. The town is on the river Cam, but Cambridge does not mean "Cam-bridge," or bridge over the Cam. This form appears only in the twelfth century. The older name of the river was "Granta." "Cam" is Celtic, "crooked,"[3] i. e. the name originally meant "crooked ford."

The origin of even comparatively modern names is also apt to be lost. Some interesting illustrations from South African place names have been discussed in the *South African Journal of Science*.[4] Bloemfontein may be instanced. This name is variously derived from "flowers and springs" and from Jan Blom, a notorious outlaw of some hundred years ago.

In arriving at the derivation of such place names as those discussed above, dependence is largely placed on documentary evidence. But there is no such line of investigation before the student of Indian place names. All that the observer can do is to ask an Indian what a certain name is believed to mean. A large proportion of these names can be correctly explained, but there is always the difficulty of telling absolutely and finally which out of a number of explanations is correct. As has been said, there is an element of uncertainty here which no scientifically minded person would deny.

The psychological factor back of the difficulty is this: that an informant, especially if he be untrained in the methods of scholarship, will give as the meaning of a name, anything which *sounds* correct. There is a place in England (in Staffordshire) called Talk-on-the-Hill; and the country people explain to strangers that Charles the First held a council of war there. The name is really from the Celtic *twlch*, meaning a "knoll." When the Celtic tongue passed away from the neighborhood, and Saxon came to be spoken, the old name remained but meant nothing to the newcomers; eventually *twlch* was made over into "talk" and the story about Charles added to account for the name. In the state of Washington is a small town called Colby. A local historian quotes seriously a correspondent who says the name was derived from *Coal Bay*, "because some one found a lump of coal by the creek there." Such naive explanations never fail to be entertaining, and no doubt similar "folk etymologies" exist in my own notes concerning Indian names, though the greatest care has been taken to get the etymologies as accurately as possible, and most of them seem to be genuine.[5] With this preliminary caution I now proceed to discuss some of these results.

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[2] Johnston, *op. cit.*, p. 391.

[3] Isaac Taylor: Names and their Histories, New York, 1896, pp. 81–82.

[4] Charles Pettman: An Inquiry into the Derivation of Certain South African Place Names, *South African Journ. of Sci.*, Vol. 12, 1915–16, pp. 159–170 and Vol. 16, 1919–20, pp. 432–442.

[5] On the difficulties of determining the origin of Indian place names compare A. L. Kroeber: California Place Names of Indian Origin, *Univ. of California Publs. in Amer. Archeol. and Ethnol.*, Vol. 12, 1916, pp. 31–60

## Characteristics of Indian Place Names

Indians are extraordinarily industrious in applying and inventing names for places. On Puget Sound alone, there seem to have been in the neighborhood of ten thousand proper names. I have secured about half of this number, the remainder having passed out of memory. I am continually warned by Indians that they give me for my maps only a small part of the total number which *once* was used. The rest they have either forgotten or never heard. "The old people could have told you all" is the remark most commonly heard. The vast majority of these names were explained to me after a fashion, but in some cases the Indians themselves had no idea what the name meant, explaining oftentimes that it might be in some foreign or forgotten language. This difficulty, of course, is one commonly experienced in endeavoring to get the meaning of place names among primitive folk—or indeed, one may say, among uneducated people in general. Rodway says the same thing about the Indians of British Guiana. "They use the same words as their fathers but do not trouble to find out their meanings. In some cases the original inhabitants have died out; even tribes are entirely lost, with not even a parrot to give us an idea of their language."[6]

## The Vast Number of Local Names

Thus, one phenomenon of wide occurrence among primitive tribes is the vast number of local names in use. In some places in my area the names are so numerous that I could not enter them on a Geological Survey topographic sheet. Even when I represented each name by a number (compare the map herewith) the figures became so crowded together that the whole became illegible. These names often refer to very minute places in the topography. Indeed, it may be stated as a rule that there is a large series of names for small places, with astonishingly few names for the large features of the region. A special name will often be given to a rock no larger than a kitchen table while, on the other hand, what we consider the large and important features of a region's geography often have no names at all. Mountain ranges are nameless; there are no names for bays; in the case of one tribe, the Yurok of northern California, the rivers have no proper names of their own; and islands are nameless, almost without exception.[7] Of 718 names which I collected in the immediate neighborhood of Seattle, independently of other inquirers, less than two dozen referred to the large features of the coast line and relief. In the case of more than 2,000 names collected in northern California, the proportion was even less. This is best illustrated by a few concrete examples.

The Yurok once gave me 12 place names on the slopes of a mountain.

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[6] James Rodway: The River-Names of British Guiana, *Bull. Amer. Geogr. Soc.*, Vol. 36, 1904, pp. 396–402; reference on p. 400.

[7] See the author's paper "Yurok Geography," *Univ. of California Publs. in Amer. Archeol. and Ethnol.*, Vol. 16, 1920.

# SEATTLE REGION
## INDEX MAP TO INDIAN PLACE NAMES

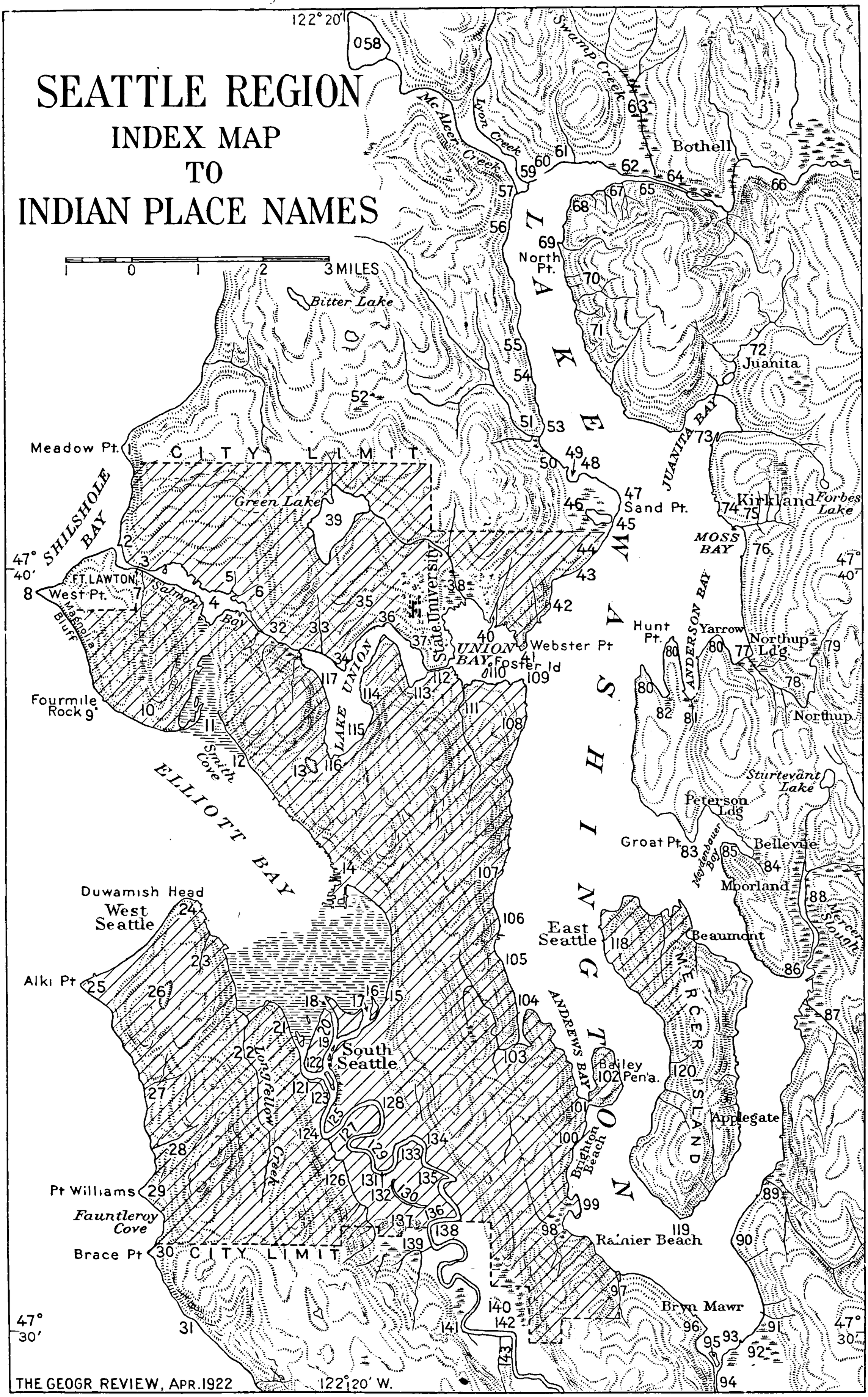


FIG. 1—Key map to Indian place names in the neighborhood of Seattle. Numbers have reference to the names discussed in the Appendix. The shaded area represents the approximate limits of the city of Seattle. The map (scale 1 : 170,000) is based on the U. S. Geological Survey's topographic sheets, Snohomish and Tacoma quadrangles.

One place was an echoing cliff where they shouted out questions about the future, i. e. a place of religious interest; another place was a camas meadow —here the interest is purely dietary, camas being an edible root; another was a place where several trails crossed; and another where passers-by carried out certain observances, i. e. a place of ceremonial interest; but meanwhile they had no name for the mountain *as a whole*. I traveled once on foot for three days toward a great promontory, which, I understood, was called Cu'mig ("Patrick's Point"). When I got there I found that Cu'mig was merely a shelving rock on the side of a promontory.

The Indians of Puget Sound have no names for the Sound, as a body of water, except xwaltc, "salt water," which term they also apply to the Pacific Ocean. I doubt if the Sound ever obtruded itself as a unit into their con-

FIG. 2—The rocks off the extreme tip of Cape Flattery, Washington. These rocks are nothing more than shelving ledges, pounded by a boisterous sea, but they all have their names. The one in the background is called Aawa'tu, or "bald eagle." These birds used to perch on this rock, watching for herring. (Photograph copyrighted by Asahel Curtis.)

sciousness. One of the most conspicuous features of the Sound is a large expanse of land known as Bainbridge Island, lying opposite Seattle. The Indians of Bainbridge Island and of the adjacent shores had no name that I can discover for Bainbridge Island itself. They had, however, upward of three hundred names for different places *on* the island. I have recorded nearly a hundred of them myself. If an Indian in a canoe were "headed," as he would say, for Bainbridge Island and were asked where he was going, he would in reply name the *spot* where he proposed to land. Another striking feature of the Sound is an extraordinary number of narrow inlets. In one place near Olympia an observer in a boat can look into seven inlets at once, raying out like the spokes of a wheel. These inlets have no Indian names. The Indians of Dye's Inlet have, as far as I can discover, no name for the inlet (this is near Bremerton; often called Port Washington). They have

FIG. 3

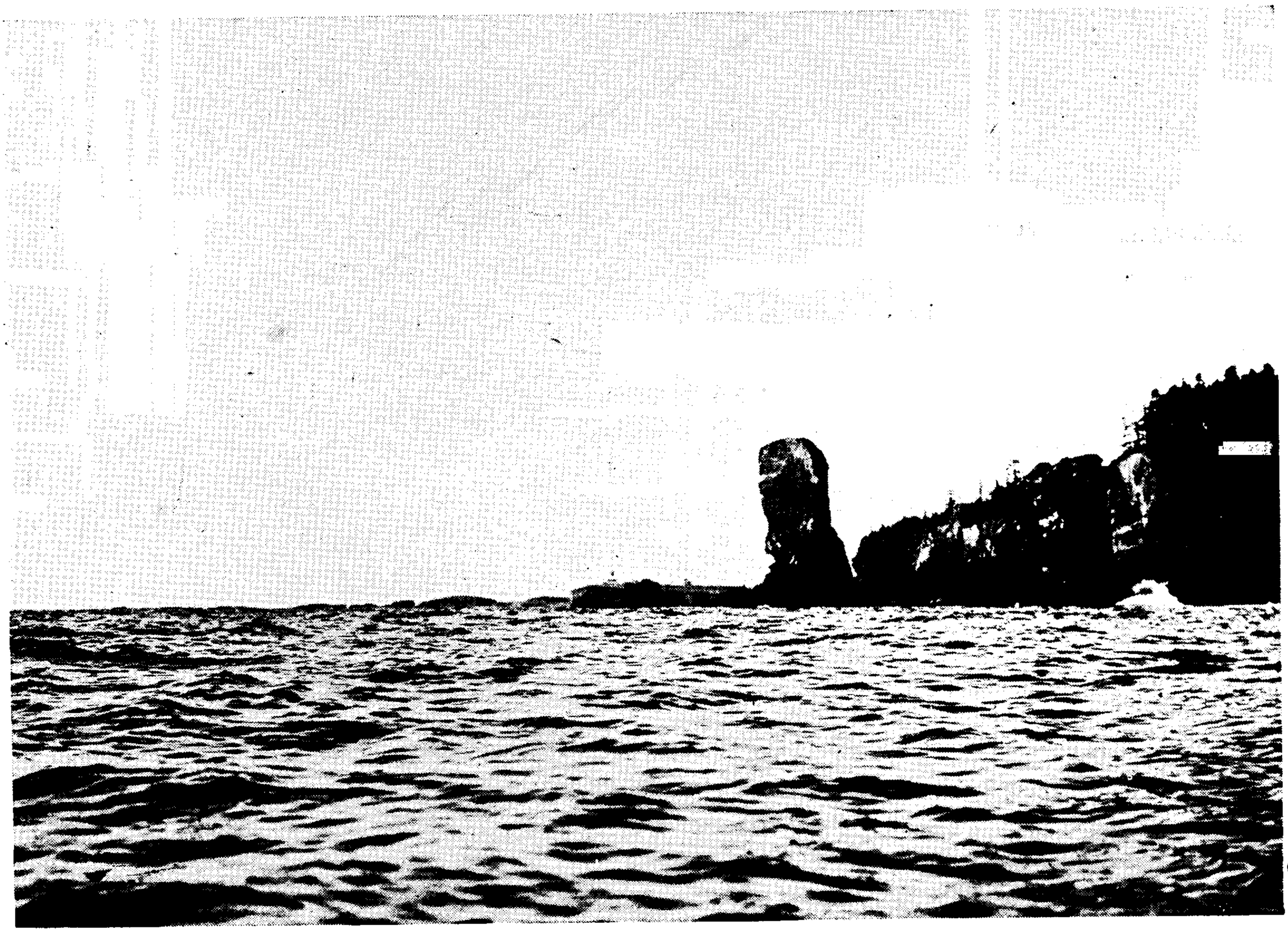

FIG. 4

FIG. 3—A view of Cape Flattery and the village at Neah Bay. There is a marked contrast, as regards the occurrence of names, between the hills which cause this cape to loom so large and the sea-rocks lying around its base. Only two of the mountains have names: "Trees scattered" and "Cranberries" (CELce'yus and Pap!e'stao's, in the local dialect). (Photograph copyrighted by Asahel Curtis.)

FIG. 4—The cliffs at Cape Flattery, with Flattery Light in the distance, at the entrance to the Strait of Juan de Fuca. The great crag in the picture is named Fuca's Pillar, after the famous pilot: its Indian name is Tsatsada'x, "standing rock." (Photograph copyrighted by Asahel Curtis.)

a desperately rough series of vocables, Sxaqt, which serves in a general way as a designation of direction thitherward but is really the name of an important Indian village site on the inlet. This site lies on a sand spit east of the town of Silverdale. I have been at Sxaqt and have walked over the site, and it is not more than one eighth of an acre in extent. The Indians had no occasion, it seems, to refer to the harbor as a whole.

I may here stop to remark on the broad significance of this characteristic. Compared with analogous instances among other primitive peoples it appears as an interesting reflex of primitive modes of thought and expression.[8] One may perhaps regard it as a cultural index to some degree. Churchill speaks of "the abundance of minute place names and the almost total absence of designation for the larger geography of islands and archipelagoes" in the South Pacific.[9] Extreme examples of this sort of thing are found among the Melanesians. Polynesians and Micronesians have reached the stage of naming their own individual islands while the Samoans have gone as far as acquiring a "national and archipelagic designation."

## Meanings of Indian Place Names

Another difference between our nomenclature and that of the Indian is seen in the nature of the names which the Indian applies to his topography. A good deal of time and effort has been expended in inventing outright rather mawkish terms, which are styled place names and ascribed to the Indian. Thus, some one has put down Mt. Rainier as having an Indian name meaning "nourishing bosom," and this "on account of the numerous streams which spring from the glaciers." "Home of the Winds" is applied to a second peak. As a matter of fact, neither of these terms bears inquiry for a moment; I never found an Indian who recognized them, nor have I ever recorded any Indian place names at all analogous to them. This, however, is not to say that the Indian lacks poetry in his make-up. He has the poetic instinct and along with it an appreciation of beauty, ranging from that of basket designs to that of majestic scenery. But his "poetry" does not take the form of far-fetched metaphor nor clothe itself in weak and transparent allegory. Nor does the Indian sentimentalize over the scenery.

The actual place names used by the Indian, as far as those which I have obtained may be considered as evidence, are of a totally different character from those I have just mentioned. The vast bulk of his names are descriptive and commonplace. For example, a thing he is intensely interested in is food, having a distinct resemblance in this respect to ourselves. Our food, however, comes to us so easily and regularly, as the result

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[8] Compare J. R. L. Kingon: A Survey of Aboriginal Place-Names, *South African Journ. of Sci.*, Vol. 15, 1918–19, pp. 712–779. Treating of this feature of native place names in South Africa he says: "Everyone who has had any insight into the Native mind and method will be familiar with the immense detail which burdens their narratives of even simple events—and, naturally, this immense detail is to be reckoned with in any study of the place-names, for the smallest of places seems to have its name" (p. 713).

[9] William Churchill: Geographical Nomenclature of American Samoa, *Bull. Amer. Geogr. Soc.*, Vol. 45, 1913, pp. 187–193; reference on p. 187.

of our economic and industrial system, that we have to take no direct thought concerning it. Not so with the Indian. He lived on a plane where economic security was undreamed of, and, after breakfast was over and the "things cleared up," luncheon became usually a matter of the greatest moment and the liveliest concern. It is not astonishing, therefore, to find

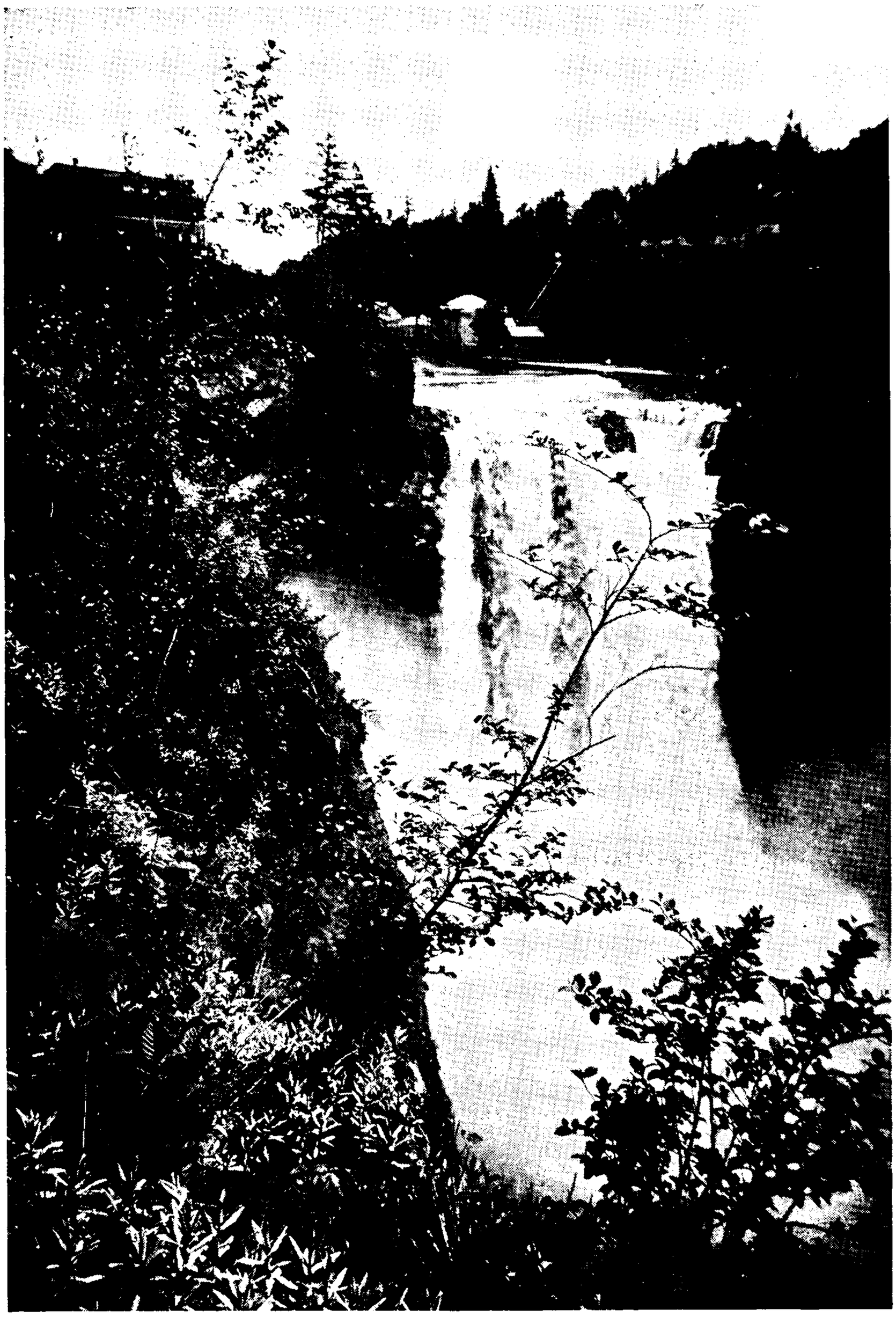

FIG. 5—Snoqualmie Falls, Washington. The river plunges with wild abandon into a rocky caldron, amid a fury of sound and a storm of spray. The bottom of the falls the Indian calls simply Sqwud, or "below part." The rim of rock over which the river leaps he calls SkaLdaL, the word for a person's upper lip.

that a large number of Indian geographical names bear directly on his food supply. Names like "Dog-salmon place" for an inlet or "Wild-potato place" for a meadow are part of the prevailing mode in place names. A very large item in his geographical psychology is the grounds where materials are obtained for technologic processes. "Cedar place" and "Where-they-slide-

planks-down-from-the-hillside" are examples. Along with these commonplace terms, place names famous for their mythological significance are very frequent, associated closely with spots sacred to supernatural beings—spots particularly where various taboos are to be observed. I have in mind, for example, a certain big rock on the Klamath River, in front of which no woman or corpse is allowed to pass in a canoe. The rock (or the being who dwells in it) will not permit such familiarity. Women walk, and corpses are carried, on the *landward* side of this rock and re-embark in the canoe out of eyeshot. There are a number of such boulders along the Klamath, and each one has its own proper name. At Bremerton, Wash., near the great Puget Sound Naval Station, is a small rock called Xa′xE', "forbidden." No canoe may run aground on this rock. If that should occur, the occupants would soon die—unless, perchance, they know the proper song to sing. This song, in my own orthography,[10] is as follows:

LatL'a′xtcEda′l tis wat'i̱ᵘ̱tid
gwEla hṓi yahaL

"I will continue to grow in this world
Then it will be good for me!"

In a list of Indian place names there are likely to be hundreds of this character. Often the rocks and other topographic features which figure in the myths are to our eyes most unimpressive, while places impressive to us often remain nameless. For example, the state of Washington boasts one of the finest cascades imaginable, Snoqualmie Falls. A considerable river leaps out over a bluff and descends into a chasm with thundering reverberation and a cloud of mist. One would certainly suppose that the neighborhood would be a place of more or less mystery and awe. I own I expected to encounter something very impressive in the way of names when I asked what the falls were called. The place where the water descends, where the thunder of its fall is loudest, is called Sqwud, which means "underneath" or "below." The upper part, where the waters take their leap, is called SkaLdaL, or "lip." Here, in the most romantic surroundings, Indian nomenclature is most laconic and matter-of-fact. On the other hand, the Indian is often affected by very commonplace objects. I was told that a certain region along the shore south of Seattle was "mysterious." The Indians never went there; they never even looked in that direction. This was because there was a certain wonderful rock there, it seemed, that shed its potent influence over the whole landscape far and wide. If any one looked at it, he became twisted! His head, from the power of the rock, would twist right around on his neck, and so on. The very Indians who told me about the boulder had themselves never seen it because they were unwilling to go near it. It turned out that this boulder was not more than four feet high—a most ordinary-looking red stone; and I could not help wondering

[10] For the Values see Appendix, p. 187.

in what quaint and curious way and by what strange psychological twist its reputation for the marvelous had become established and spread abroad.

The examination of Indian local names opens up most interesting material in the way of folklore, and we have in myths and religious sentiments an important source of Indian geographical names. A certain number of Indian places get their names from the accidental resemblance of rocks or other natural objects to living creatures. The resemblance in such cases is seldom striking, the barest suggestion of a resemblance often seeming remarkable to the Indian's mind. But such origins are relatively rare. I have recorded "resembling a bosom," "standing like a person," and "elk, similar-to" among others. However, the place names that contain the stem "elk" or refer to the elk usually indicate the actual presence there of the animal in question and not to a myth about it, or anything in its contour.

The repeated use of a given geographic name is characteristic of the Indians, as of ourselves. In our own maps of the various states or counties, the number of Pine Creeks and Mill Creeks and Rock Creeks and Deer Creeks and bald and meaningless town names ending in -ville is almost appalling. Similarly there are certain geographic names which are very popular among the Indians. In the region of Puget Sound the most popular name contains the stem *ba'kwob*, which means "prairie," or open place among the trees. It occurs in a number of forms—Ba'kwob, Baba'kwob, Ba'q baqwob, BEbqwa'bEbs, SbEqwa'bEqs. Another stem which recurs very often is *bul*, which means "to boil." Thus we find Bul'äts, a place in a bend of Port Washington harbor where springs issue forth on the beach; Ba'lE'q, a bog near the Dwamish River with a spring in the center of it; BE'lspidop, a place in the river where the water boils up; BElqks, "boiling promontory," a place near Bremerton where the tide rips boil around the tip of a point; and a place called Bu'lbul'Ets in Quartermaster Harbor where there are several springs on the beach. All of these contain the same stem.

The actual statistics concerning the various sorts of names used by the people of one specific area on Puget Sound may serve as an example of primitive nomenclature.

| *Place Names Consisting of:* | *Number of Such Names* |
|---|---|
| Descriptive terms | 202 |
| References to mythical episodes | 67 |
| References to animals | 35 |
| References to the food supply | 34 |
| References to human activities | 33 |
| References to plants | 24 |
| Unclassified terms | 49 |
| Untranslated terms | 137 |

There is obviously some overlapping among the above categories. For example, the term "Food supply" includes certain items which might also go under the term "Animals." The list shows clearly, however, a pre-

dominance of descriptive terms and mythological allusions. The descriptive terms consist of a great variety of expressions. Some of them have reference to parts of the body, based on real or fancied resemblance in configuration; others consist of expressions such as "curled about," or "thrust out," or "sand spit projecting out under a headland," or "abounding in miry places."

## Indian Place Names About Seattle

In order to illustrate the large number of Indian place names found in a region and to give some impression of the Indian's psychology and the way in which terms are applied, I have selected for reproduction a small portion of a map showing the Indian names for places on the eastern side of Puget Sound. The area is just in and about the city of Seattle. The actual topography is very interesting, and the spot is doubly interesting because of the great city which has grown up there. The Indian names obtained are given as an Appendix to this article.[11]

From our own standpoint, the Indian's conception of the size of the world is startlingly inadequate. In southern California I obtained from a Diegueño Indian a sketch of the universe as he knew it, including the mountains which lie on the uttermost rim of things. His world was inclosed between four peaks, Mt. San Bernardino, Mt. San Jacinto, Coronado Island, lying just off of San Diego harbor, and a mysterious mountain on the lower Colorado River. Thus his world was a disk only about two hundred miles across. The Yuroks in northern California were not quite so cramped. They knew of a lot of mythical regions beyond the sky, while the expanse they were actually acquainted with in a geographic sense was limited practically to the five counties of Del Norte, Humboldt, Siskiyou, Trinity, and Shasta.[12] The Indians on Puget Sound had a still larger outlook, being a seafaring people and somewhat widely traveled; but even they place the boundaries of the horizon within twenty days' journey. The old Indians I have talked with knew in a way of the city of Washington, because the President and the Commissioner of Indian Affairs live there; and of Chicago and St. Louis, because they send their furs there for market; but the older people, at least, have no idea of the distance from the Pacific Coast to these places. All of these people picture the earth as flat and the sky as a solid vault overhead.

Geographical concepts certainly have undergone a very remarkable development. The concept which seems the simplest and most obvious, such as giving the whole of a district, or the whole of a mountain-range, one name, has actually been, like the concept of the real size of our world and its sphericity, the result of long evolution.

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[11] Another author, Costello (in the *Siwash*, Seattle, 1895), has given a brief list of native names in this neighborhood.

[12] See the diagram illustrating the Yurok idea of the World reproduced in the *Geogr. Rev.*, Vol. 10, 1920, p. 414.

## Appendix

The names in the Seattle area, as obtained by myself, are written out in the phonetic orthography used by ethnologists. A special way of writing Indian words is rendered necessary by the fact that the Salish dialect spoken at Seattle has many sounds which do not occur in English. Briefly, in the names here printed the ordinary vowels have their European value. The symbol "E" has the sound of "u" in "but;" "L" is a surd "l;" "$^{q}$" is a velar, or "back," "k;" "c" has the value of English "sh;" "tc" has the value of "ch" in "church;" "x" the value of "ch" in Scottish "loch;" the apostrophe (') is a glottal stop. In connection with pronunciation consonants marked ! are exploded, and ′ is a stress accent, as in English. Open vowels are marked with a breve (˘). Letters printed above the line indicate sounds which are imperfectly articulated.

The numbers printed in front of these names indicate position on the map, where they are entered in the proper order beginning at the northwestern corner.

### Names of Places on the Shore of Puget Sound Near Seattle

1. Meadow Point, a sandy promontory north of the Ballard District, Seattle: Qe′L$^{E}$bEd. The word suggests Qe′lbid, "canoe."

2. A very minute promontory, barely visible on the map, at the northern side of the entrance to Salmon Bay in the Ballard District, Seattle: Tce′dkedad, "lying curled on a pillow." The name refers to the shape of the spit, which is curled about on itself, owing to the wash of the tides at that point. There were formerly many clams here.

3. The narrow opening which leads into Salmon Bay: Cilco′l-utsid, "mouth of Ci′lcol" (see below).

4. Salmon Bay: Ci′lcol, "shoving a thread through a bead;" "threading or inserting something." The Indians used to paddle in from the Sound and traverse the length of this inlet on their way to Lake Washington. The name refers to the way in which this narrow estuary invades the shore line. Costello gives for Salmon Bay "Shul-shale, the name of a tribe." He is very much misled in this matter. The tribe were the Cilcol-a′bc or "Shilsholamish," "dwellers on Shilshole." It is noteworthy that the word Shilshole, which is a transcription in ordinary spelling of the Indian name, still appears on the map, but it has drifted down with the tide, so to speak, and has now come to rest in the waters outside of the "heads," which are the Shilshole Bay of recent published maps.

5. A very small creek entering the northern side of Salmon Bay: Bitida′kt, "a kind of supernatural power." This "power" enabled one to journey to the underworld and recover souls from the land of the dead. The performances and paraphernalia of the ceremony have often been described; for example, by Dorsey, in the *Univ. of Pennsylvania Museum Bulletin*, and by Haeberlin, in the *Amer. Anthropologist.*

6. A still smaller creek than the above, entering the same tiny inlet: Qw!ula′stab, "a small bush with white flowers and black berries." This is not the dogwood, as might seem likely, but some other plant.

7. A creek which drains down a straight gully into the southern side of Salmon Bay from the neighborhood of Fort Lawton: Hwiwa′iq, said to mean "large; having lots of water."

8. West Point, a promontory ending in an elongated sand spit: Pka′dzEltcu, "thrust far out." This cape lies just north of Seattle harbor, or Elliott Bay. The stem is *paLkt*, "to thrust ahead," or "to push one's way through brush," for example. It is also used of leaves "pushing out" in the spring. The terms refers to the way in which the point seems to thrust itself forward into the Sound. Costello gives Per-co-dus-chule, not translated.

9. Four-mile Rock: LE′plEpL. The rock in question is a great boulder standing in the water at the foot of Magnolia Bluff. Its name was also recorded in the form La′pub. Another name, Tc!ĕ′tla, which is sometimes used, means simply "rock;" "boulder." A myth recounts that an ancient hero named Sta′kub could take a gigantic dragnet made of cedar and hazel branches and throw it over this rock while standing himself on the distant beach.

10. A small creek draining down a gully from Fort Lawton: TLo′xwatL-qo, "land-otter water." This creek flowed only in wet weather. The gully is now occupied by a paved road.

11. Mouth of the creek draining into Smith Cove: Sila′qwotsid, said to mean "talking."

12. A creek formerly entering the Sound south of Smith Cove: T!E′kEp, "an aerial net for snaring ducks." It is said that ducks which were "started up" on Lake Union would always fly over the low place between Queen Anne Hill and the business district of Seattle. Duck snares were accordingly set at this point. It is also said to have been used by the Indians as a camping place.

13. An open space, or series of spaces, in the forest which formerly grew north of what is now the business district of Seattle: Baba′kwob, "prairies" (*ba′kwob*, "prairie"). The earliest white settlement at this point was called Belltown. It lay just north of the present water front with its wharves.

14. A village site in Seattle: Djidjilal'ĭtc, a diminutive, meaning "a little place where one crosses over." At this point there formerly extended a little promontory with a lagoon behind it. On the promontory were a few trees, and behind this clump of trees a trail led from the beach over to the lagoon; hence the name. Indian villages existed on each side of this point and flounders were plentiful in the lagoon. This is exactly where the King Street Station now stands. The term for this spot is now applied by Indians to the whole city.

15. A little "spit," or beach, at the edge of the easternmost of the mouths of the Dwamish River: $^{Tux}$pa′ctEb.

16. A small promontory on an island: Tĕta′lks. The place is said to have been used as a lookout point by the Indians, who built a stockade here.

17. A slough passing to the south of the above: Slu′wĭL. The term means literally "a perforation for a canoe." The word *slu* is applied, for example, to the holes bored to test the thickness of a canoe hull. In the present case the word refers to a grassy marsh intersected with channels, into and through which canoes can be pushed. The term was also defined to me as "a short cut;" "a canoe pass."

18. The largest of the branches into which Dwamish River divides at its mouth: XwEq!, "slough."

19. A place on the western shore of the above slough: Q!ulq!ula′di, "shaggy," "tangled." The stem *qul* means "bad," "brushy." A lot of fir "snags" or "stubs" (that is tree trunks with the roots attached) drifted in here and lodged, masking the shore so that no one could land.

20. Harbor Island, a flat surrounded by watercourses, and rather marshy: Ts!E′kas, "muddy." An old informant, George Si′towaL, lived in a float house here with his aged wife until in the year 1920 they starved to death.

21. An old village site on the western bank of the Dwamish, at the foot of the bluff: Tul'a′lt$^{u}$, "herring's house."

22. Longfellow Creek, draining into Young's Cove, in West Seattle: Tua′wi, "trout."

23. A trickle of water draining down a little gully near Luna Park in West Seattle: $^{Cl'x\dot{u}}$tsE′xud, "something to split with."

24. Dwamish Head: SqwEdqs, "promontory at the foot of something" (*sqwEd*, "the under part of anything;" *qs*, "promontory"). The name is descriptive of the sand spit which juts forward from the foot of an abrupt overbeetling headland, once heavily timbered. Costello gives the name Squ-ducks for this place, translating it "promontory."

25. Alki Point: SbEkwa′b $^{E}$qs, "prairies" (*ba′kwob*, "prairie"), so named because the flat, sandy promontory, which juts out half a mile from the shore line, had among the trees many open places.

26. A depression a mile or more inland from Dwamish Head: $^{Tux}$qo′tEb. This lies on top of the plateau and was once a cranberry swamp.

27. A small creek south of Alki Point: T!E′sbEd, "a winter house" (*t!as*, "cold"). The reason for giving this name to the place I do not know. There was a brickyard here some years ago.

28. Another small creek, south of the preceding: GwEl, "to capsize."

29. Point Williams: Tcĭxha′idus, "crowded," "tight."

30. Brace Point: Psaiya′hus, "horned snake." This promontory was considered to be the abode of one of these monsters. They were regarded with supernatural dread. They take the form of an enormous snake, having, according to some accounts, the antlers and forelegs of a deer. At the base of this promontory is a big reddish boulder weighing half a ton or more. It was formerly believed that anyone looking at this boulder would become twisted into a knot. The boulder itself was believed to change its form. Certain people had this boulder for a supernatural helper.

31. A bend, or cove, south of Brace Point· $^{Tu}$kwa′sus, "scorching the face." There is a gravel pit here now.

## Names of Places on Lake Union and Lake Washington

The author already mentioned, Costello, gives two curious words for the names of these two lakes. He says that the name for Lake Washington is At-kow-chug, meaning "large body of fresh water," while for Lake Union he gives the name Kah-chug, which he translates "lake." As a matter of fact these two expressions are forms of the same word, though from our author's way of transcribing them one would hardly suspect it. The word for Lake Washington is Xa′tcu, which is simply a word for "lake." This is the one spelled "At-kow-chug" by Costello. To form the name for Lake Union, the Indians insert a "glottal stop" in this word, which makes a diminutive of it and gives the form Xa″tcu. This closely resembles the other word but means "little lake." Used as a name for Lake Union, it is the term written by Costello "Kah-chug." His remarks are therefore an indirect approximation to the truth. Lake Sammamish, which is east of Lake Washington, the Indians call Xa′tcxatcu, which also means a small lake but one not quite so small as a Xa″tcu.

32. A place on Lake Union, where an outlet drains into Salmon Bay: Gwa′xwop, "outlet." The stream flowing in this channel now supplies the locks of the Government Canal.

33. A small creek, just east of the railroad bridge in the Ballard District, Seattle: Ctcĭwa′t-qo, "place where one whips the water." The people used to hit the water with sticks to drive fish into the narrow brook, where they were easily captured.

34. A promontory jutting into Lake Union from its northern shore: Stĕ′tciL, "a prop." It looks, say my informants, as though it were "leaning against" the opposite shore. This promontory is now occupied by a gas plant.

35. A "prairie," or open space, near Lake Union: Ba′qwob. This was at the northern abutment of the Latona bridge, in the city of Seattle.

36. A small creek entering Lake Union just east of the Latona bridge: Waq!e′q!ab (waq!e′q!, "frog").

37. A tiny promontory jutting into Lake Union, where the boathouse of the University Boat Club now stands: Sqwitsqs, "little promontory."

38. The marsh lying between Laurel Point and the buildings of the University of Washington: SLuwi′L, "perforation for a canoe." The term refers to the fact that the marsh was intersected with channels into which a canoe could be thrust. The creek which enters the bay through this swamp flows out of Green Lake through a conduit into Ravenna Park. A large aboriginal fish trap made of piles formerly stood in this bay. Its ruins are said to have been exposed some years ago when the level of the lake was lowered by the digging of a canal.

39. Green Lake: $^{Du}$tLĕ′c. This lake furnished quantities of suckers and perch, which were taken in basket traps. Salmon also entered the lake by the creek mentioned just above.

40. A little cove on the western side of Laurel Point: A′did, an exclamation translated "Dear me!" The spot was formerly the property of a certain Joe Somers and previously to that had been set aside as a camping place for Indians.

41. Laurel Point: Cebu'lt$^{u}$, "dry." This promontory is now called "Webster Point" on the maps and is styled "Whiskey Point" by Indian informants.

42. The shore of Lake Washington, north of Laurel Point: $^{Tu}$tsa'xwub, "beating." A fine cliff here, overshadowed with heavy timber, overhangs the beach.

43. A spot on the beach north of the preceding: T!lels, "minnows," or "shiners." These are otherwise called tomcod, I believe.

44. A flat open area without timber, south of Sand Point: BEbqwa'bEks, "prairies" (*cf. ba'kwob*, "prairie").

45. A little channel which drains a pond south of Sand Point: Tc!aa'Lqo, "channel," "watercourse." There is a myth which refers to this channel, but I could not obtain the details.

46. The pond at Sand Point: Wisa'lpEbc.

47. Sand Point, an extensive promontory, very level: Sq$^{w}$sEb.

48. The northern shore of Sand Point: T!uda'xEde, a plant with small, inedible white berries.

49. Cove at the inner end of the promontory: Sla'gwElagwEts, literally "cedar bark, where it grows."

50. The shore north of the preceding: XwExwi'yaqwais, said to mean "pulling on a line which is made fast to something."

51. A creek north of Sand Point: $^{Tu}$xu'bĭd.

52. A cranberry marsh lying some three miles from the lake shore: SLo'q!qed, "bald head." This marsh is drained by one branch of the creek just mentioned.

53. A little promontory: Tsixtsix-a'lt$^{u}$, "eagles' house." There is the nest of an eagle (*tsistsis*) in a tree on this point.

54. A place on the lake shore, at the edge of a bluff: Xwiyaqwa'dĭ-a'lt$^{u}$, "thunderbird's house." The mythical fowls which are supposed to cause thunderstorms by clapping their wings and winking their eyes were believed to nest here in the trees.

55. A very "dangerous" place at the edge of the lake: StL!Epqs, "deep promontory." People swimming here were formerly "taken away" by something supernatural.

56. An enormous boulder on the lake shore: $^{Bs}$tcĕ'tla, "rock."

57. The mouth of McAleer Creek: S!a'tsutsid, "mouth of s!a'tsu." (See No. 58.)

58. McAleer Lake: S!a'tsu, "face."

59. A small creek: Sts!kE'l, "a certain small bird."

60. A spot where a sawmill stands, at the northern end of Lake Washington: Sta'tabEb, "lots of people talking."

61. A small creek: Tcĕtca'L.

62. A level flat at the mouth of Swamp Creek: Ts!Ebta'lt$^{u}$, "elderberry's house" (*ts'abt*, "elderberry").

63. Swamp Creek: TuLq!a'b, variously translated. The word Lq!ab means "the bark of a dog." Another informant said that the present term means "the other side of something," like the opposite surface of a log.

64. An old village site on the northern shore of the lake, at its head, near where the Sammamish River enters: TL!ahwa'dĭs, "something growing or sprouting." According to informants dwelling on the Sound the people here were "poor."

65. Where Sammamish River enters Lake Washington: Cxa'tcugwEs, "where the lake becomes elongated." The expression refers to the way in which the lake at its northern end gradually narrows into a long estuary.

66. Squawk Slough, otherwise known as Sammamish River: sts!ap, "crooked," "meandering." This stream was originally crooked almost past belief. It has now been dredged out and straightened, so that mill logs can be floated through it from the lake above. The people living here were called the sts!apa'bc, "meander dwellers," anglicized as "Sammamish." This name for the people has now been applied to the lake and the river.

67. Peterson's Point: Qwai'tĕd, said to mean "across." This is a headland lying south of the mouth of Sammamish River.

68. A small promontory: Xwi'alad$^{xu}$, "niggardly;" "scanty." It was difficult to catch fish at this place; whence the name.

69. North Point: U'a's, "gravel rattling down." Gravel continuously rolls down from this promontory.

70. A spot on the eastern shore of Lake Washington, south of the preceding: Li'lskut.

71. An open space near the present town of Juanita: Tcĕ'tcubEd.

72. The creek at Juanita: TE'btubĭ$^{u}$, "loamy place" (tE'b$^{u}$, "earth," "loam").

73. Nelson Point: Leqa'bt, translated "paint." The term means literally "something gathered or scooped up with the fingers." Material called "rust" by my informants (evidently ochre) was scraped from a cliff at this point and baked in a bonfire. The reddest portions were then picked out and used for face paint.

74. The beach north of the town of Kirkland: Wĭcqab-al't$^{u}$.

75. A water channel on the hillside north of the town of Kirkland: Tse'xub, "dripping water."

76. The site of the town of Kirkland: Sta'LaL.

77. The mouth of Northup Creek, south of Kirkland: Tc!u'tsid, "mouth of Tc!u." (See below.)

78. Northup Creek: Tc!u.

79. A swamp at the head of Northup Creek: Txwa'bats, "pulling something toward one."

80. Three promontories with narrow inlets between: "SLi$^{u}$Li'uqs, "three promontories" (*Liux*, "three"). The promontories are Hunt Point, Fairweather Point, and a third which has no name in English.

81. A small creek at the head of Anderson's Bay: Tca'bqwEsEbEts.

82. A small marsh at the head of the inlet west of the above: DE'q!tus.

83. Groat Point, near Peterson's Landing: CtcE'gwus, "place where a trail descends into the water."

84. A little creek at head of Meydenbauer Inlet: TLhai'si, named for a certain species of fish. This fish, called *tLhais*, has a stripe on the side and is very bony. They "ran" in great numbers at this point.

85. A promontory south of Meydenbauer Inlet: Lcwild.

86. A promontory west of Mercer Slough: TL!utsa''lus, "tying a mesh."

87. Coal Creek: SqE'bEqsĭd.

88. Mercer Slough: Sa'tsakaL, "water at head of a bay," an old village site.

89. May Creek: Cbal't$^{u}$, "place where things are dried." Great quantities of redfish were taken at this point.

90. A small promontory: Kwa'kwau.

91. A place opposite the south end of Mercer Island, at the foot of Lake Washington: P!E'swi, "pressed back;" "crowded back."

92. Marshes at the south end of Lake Washington, to the east of Black River: Spa'pLxad, "marshes." The word was given to me also in the form Spapa'pLxad, "several little marshes."

93. A little promontory on the lake shore at the middle of the marshy flats just mentioned: $^{Tu}$ci'tsabd$^{u}$, "to thrust or shove," especially to shove one's canoe into the brush.

94. Where Black River flows out of Lake Washington: Ciqe'd, "head," or "source." This is "the place from which Black River starts," whence the name.

95. A place near the head of Black River (probably the small island there): Tcitc!o'yaq$^{w}$.

96. An old village site at a place now called Bryn Mawr: SExt!i'tcĭb, "place where one wades."

97. A small creek north of Bryn Mawr: Tsi'ptsip, "ducklings." The term means literally "something which emits a squeak or peep."

98. A creek draining into an inlet north of Rainier Beach: $^{Tux}$wöo'kwib, "loon." Surrounding this inlet there is a deep swamp or marsh where loons nested.

99. A promontory, separated from the mainland by the marsh just mentioned: TLĭ'Ltcus, "small island." It lies west of the south end of Mercer Island.

100. Brighton Beach: Xaxao'Ltc, "taboo;" "forbidden." Some supernatural monster lived at this point.

101. The isthmus connecting Bailey Peninsula with the mainland: Cka'lapsEb, "the upper part of one's neck." It is employed regularly in the sense of "isthmus."

102. Bailey Peninsula, especially its northern end: SkEba'kst, "nose" (bE'ksĭd, "nostril").

103. A creek emptying into Wetmore Slough: Sqa'tsĭd, "choked-up mouth;" *astqo'tsid* is is the expression for closing a door, or blocking up an opening. A lot of snags here blocked up the mouth of the creek. The place was at one time a hopyard. Silver salmon formerly frequented this creek.

104. Wetmore Slough (or place on the shore of the slough): Ska'bo, "nipple," or "milk."

105. A place on the lake shore, opposite the northern end of Mercer Island: Saiya'hos, "horned snake." This is an enormous supernatural monster which lived at this point on the shore.

106. A place slightly north of the preceding: Hwoqwe'yE-qwaiEks, "rushes used for a certain kind of matting." This rush, the name for which was given to me in the form sqwe'-qwats, is smaller than the cat-tail.

107. A place near Yesler Park: Bĭsti'Exq!e'u. This word was untranslated; but it suggested to one of my informants *stĭkla'iyu*, "wolf." The water is very deep here.

108. Madison Park, at the end of the Madison Street cable line: XĕtL, "where one chops." I do not know the reason for the name.

109. The southernmost of the two promontories forming Union Bay: Bĭskwi'kwiL, "skate." This point of land is very level and is turned up at the tip, resembling the nose of a skate.

110. Foster Island, a small island in Union Bay: Sti'tĭtci, diminutive of stE'tci, "island." This island was formerly used as a graveyard. The Indians of this part of America formerly hoisted their dead into the trees. My informants can remember when the trees here were full of boxes with skeletons in them. The lashings of these boxes gave way from time to time, and the ground was covered with bones which had rattled down from above.

111. A creek entering Union Bay from the south: Sta'LaL (*staL*, "fathom;" "stretch of the arms"). I do not know the reason for this name.

112. A place where there was formerly "portage" from Lake Washington to Lake Union: Sxwa'tsugwĭL. The stem means "to lift up." The suffix, -gwiL, is well known in the Salish dialects and means "with reference to a canoe." The whole name means "where one lifts his canoe." Costello gives this term as "Squaltz-quilth," not translated. At this point the Indians, and after them the early settlers, carried their boats from one lake to the other. The path which they followed was just south of where the present canal is cut. I am informed that a little creek drained out of Lake Washington, up which the boats were pushed as far as they could be made to go.

113. The flats at the southern end of the bight in Lake Union, facing the University campus: Spa'Lxad, "marsh," "wet flats."

114. A place on the shore of Lake Union, opposite the present site of the gas works: Sxwuba'bats, "place where jumping occurred." A number of house boats are now moored along the water front here. One informant explained that the water front here was encumbered with logs over which one had to jump.

115. A place just south of the preceding: StLĕp, "deep." The beach here is very abrupt.

116. A place at the southern end of Lake Union: Ctca'q$^{w}$cĭd, "where a trail descends to the water." At this point an old trail from Seattle harbor came down the hill to Lake Union. This is where the pioneer sawmill stood, belonging to David Denny ("Dabe Duddy" according to the Indian pronunciation of his name).

117. A bluff at the foot of Lake Union on the southern shore: TL!pe'lgwĭL, "deep for canoes."

118. East Seattle, a district on the northern end of Mercer Island: TsEktsEk!a'bats, "where gooseberry bushes grow." The particular locality named herein is the site of the old Proctor Ranch. Wild roses were formerly plentiful here.

119. South Point, the southernmost promontory of Mercer Island: La'gwĭtsatEb, "taking off;" "stripping." An old man once went to this place in a canoe to get bark from the dead trees. The influences there caused him to become "crazy," however, and he had to go away. There were supernatural beings there, called *swa'wati"tĭd*, "earth beings," living in the old stumps. Removing the bark from the stumps, therefore, was like removing clothing from a person. The Indians were afraid to go to the spot after that.

120. A place on the western shore of Mercer Island: Q!oq!o'btsi, "water lilies," a plant with a large yellow flower.

## Names of Places Along Dwamish River

121. An old village site on the western bank of the river: Yile'q!ud, said to mean a basket cap such as that worn by the Yakima people.

122. A spot at the southern end of Harbor Island: Ska'bk!abEb, "backwater where there is no current."

123. A level flat on the western side of the Dwamish: Xo'lxolp!i, "grassy place."

124. A spot on the western side of the Dwamish, where a bend in the river washes the foot of the bluffs: Tkba'le, "spot where they place an aerial net for trapping ducks."

125. A point of land on the eastern side of the river: TcE'btcEbid, "fir trees on the ground." People went there to get dry bark for fuel.

126. A small creek entering the Dwamish from the west: Ta'litc, "a frame for drying fish."

127. A slough cutting across a point: TatL!qe'd, "head of the short cut." At high tide the Indians made a short cut through a channel here in going up the river in their canoes.

128. A bank or cliff on the eastern side of the Dwamish: Bia'ptEb, "ground dropping down" (*bia'p*, "to fall"). Material is continually falling from the bank here.

129. A place below Georgetown: Ts!kwa'lad, "forked house post." The river forms curves suggesting the shape of this timber (see map).

130. A small channel across a flat on the western side of the river: Lwalb, "abandoned." It is an old river channel, the river having changed its course.

131. A place where there were numerous tree trunks and dead timber: T!a'Lt!aLusid, translated "where there is something overhead across the path." The term in its literal sense signifies the crossbeams in the roof of a house.

132. A place on the western bank of the river: Hutcsa'tci, "hand cut in two." Several legends cluster around this spot, and the Indians call it a "bad place," meaning that supernatural beings lurk here. Once some people were passing this spot in a canoe, going up river. They were conversing about the name. "I wonder why this place has the name 'hand-cut-in-two,'" said one of them. A hand suddenly rose up out of the river, the fingers of which were cut off. The hand stood up by the boat, and the supernatural being down in the river spoke. "*That* is why," was all that he said. The people, of course, were terrified.

At the time when the Transformer came two men were fighting here. He turned one of them into a large cottonwood tree on the western bank, which still shoots sparks occasionally at its ancient enemy—a big white fir across the river. One of my informants once, on a pitch-dark night, saw sparks passing back and forth across the river!

133. A large flat in a bend of the river: $^{Tu}$qwe'Ltĭd, "a large open space;" "a plain." A village stood here.

134. A place where a lot of material caved down on a trail: TEtc!gwEs, "a brace or upright supporting a rafter." I fancy that the name came from some tree trunks involved in the landslide.

135. A narrow promontory about which the river makes a sharp turn: Cka'lapsEb, "neck." This was formerly an open place where they got camas (lily bulbs) for food.

136. A place on a wide flat, near the head of the old river channel mentioned above: Hwa'pitcĭd, "where one throws something." I do not know the reason for the name.

137. A place where there are three symmetrical knolls on an extensive flat, on the western side of the river, in South Park: Qiyawa'lapsEb. The name suggests "eel's throat" to one of

my informants (*quya'u*, "eel"). The largest knoll is surmounted now by a Catholic orphanage.

138. A flat in a bend of the river on the eastern side: Xo'bxobti, "canoe paddles." Ash trees here, which supplied wood for paddles, gave the place its name.

139. A small creek entering the Dwamish from the west: GwExhwallt$^{u}$. This term suggests to my informants *gwEx$^{w}$*, "string," and *alt$^{u}$*, "house." I do not know the reason for calling it this name.

140. An isolated knoll north of the bridge where the Puget Sound electric trains cross the Dwamish on the way to Tacoma: Cxi'yaq$^{u}$, said to mean "beaver." This and two other near-by elevations stand out on the plain separate from the near-by ridge. They are the scene of a famous story, the legend of North Wind and South Wind. In effect it is as follows: North Wind, whose name is Stu'bla, had a village on the lower part of the Dwamish. South Wind had a village farther up the stream. War arose, and while South Wind and his people were destroyed. his wife, Mountain Beaver, escaped *by digging through the ground* and went to her father. There her baby boy grew up. With the help of his old grandmother, young South Wind afterwards put North Wind to flight. The last place where the latter stopped was at the present Yeomalt (west of the Sound). This name is an Americanization of Yeboa'lt$^{u}$, "fighting house," which was formerly spelled on the early maps Yemoalt (notice the order of the letters, which has undergone a change on modern maps). Here the two winds had their last "tussle." Hence the breakers roll high on that point even today. This is why we do not have constant winter in the Dwamish valley, they say. South Wind drove North Wind away.

141. A place on the hillside south of the Interurban bridge just mentioned: Stu'bla, "North Wind." This is the site of North Wind's ancient village. A few yards below this spot a great reef of rocks stretches across the river, representing his fish dam, destroyed and ruined by young South Wind.

142. A conical elevation crowned with large boulders, just at the bridge: Stkax$^{u}$, "beaver-lodge." I think it derives its name from its domelike appearance.

143. An isolated hill, with cliffs on its eastern face: Sq!u'l'ats, "dirty face." This hill is where lived the aged grandmother of young South Wind. After her people were driven away, she became very poor, and her face became dirty. This explains the mottled appearance of the cliffs. The river sweeps along the base of this elevation.

# TIDES IN THE BAY OF FUNDY

By H. A. MARMER
U. S. Coast and Geodetic Survey, Department of Commerce

The greatest known rise and fall of tide occurs in the Bay of Fundy, the arm of the Atlantic that separates the Canadian province of Nova Scotia from its sister province of New Brunswick and from the State of Maine. At its head the Bay of Fundy forks into two inlets, in the southern one of which, Minas Basin, the tide rises a vertical distance of from forty to fifty feet in a period of six hours and falls the same distance in the following period of six hours.

That the tide in the Bay of Fundy is characterized by a very considerable rise and fall has been known for many years. In some of the older publications, however, the figures given for this rise and fall appear to have been affected by a "factor of dramatic effect." As an example, we find in the Astronomy of Sir John Herschel[1] the statement that "in some places the tide-wave, rushing up a narrow channel, is suddenly raised to an extraordinary height. At Annapolis, for instance, in the Bay of Fundy, it is said to rise 120 feet." As given in the tide tables[2] the rise and fall of the tide at Annapolis is, on the average, 25 feet increasing to 29 feet at times of spring tides.

In the upper parts of the Bay of Fundy, in consequence of the great range of the tide, the shores at low water present a bare appearance, exposing to view wide expanses of mud flats. This condition greatly affects communication by water. "As regards navigation, the numerous small steamers in the upper part of the bay have to make their calls at high water and leave promptly, as all the wharves dry at about half tide. Schooners are accommodated by lying on a bench of mattress-work, against the wharves, while the tide is down."[3]

The configuration and hydrographic features of the Bay of Fundy are shown in Figure 1, which is based on Chart No. 1412, issued by the U. S. Hydrographic Office. The mouth of the bay, defined by a line drawn from Jebogue Point on the south to Point of Main on the north, has a width of 76 geographic miles and an average depth of 280 feet, reckoned from mean sea level. At Cape Chignecto, where the bay forks, the width is 25 miles and the average depth 130 feet, and above Cape Chignecto the contraction in width and shallowing in depth take place even more rapidly.

It is to this gradual narrowing of the bay and its lessening depth from mouth to head that the very considerable rise and fall of the tide in the

[1] J. F. W. Herschel: Outlines of Astronomy, 6th edit., London, 1859, p. 531.

[2] Tide Tables, United States and Foreign Ports, for the year 1922, *U. S. Dept. of Commerce Serial No. 163*, U. S. Coast and Geodetic Survey, Washington, D. C., 1921, p. 335.

[3] W. B. Dawson: Tides at the Head of the Bay of Fundy, Ottawa, 1917, p. 3.

upper reaches had generally been ascribed. "The greater rise of the tides in the upper part of this bay is attributed to its narrowing funnel form, and its shallowing bottom cooping up the tidal wave as it advances up the bay."[4]

## The Range of the Tide

The extent of the rise and fall of the tide, or more precisely, the range of the tide, increases from the mouth of the bay to its head. Taking the Nova

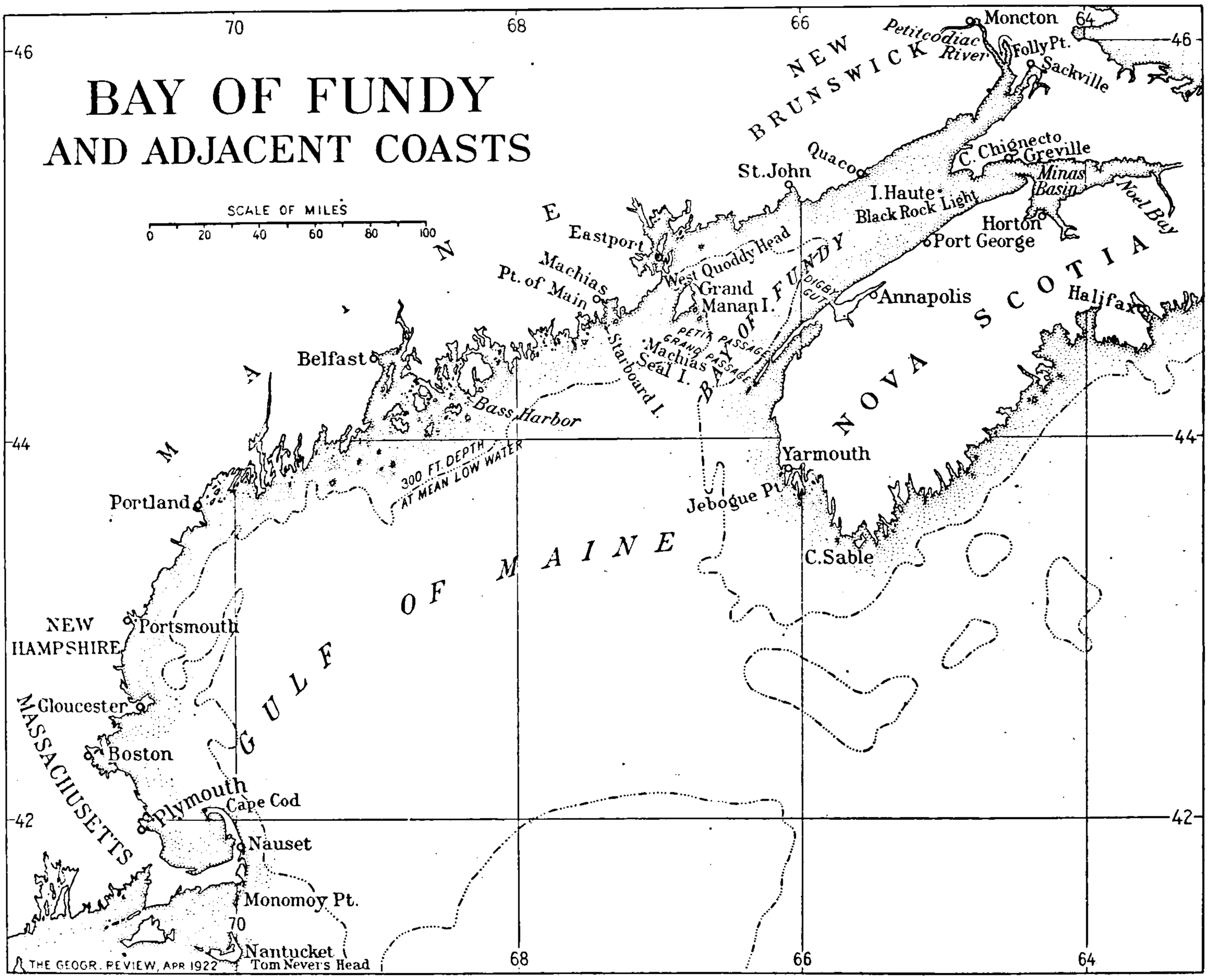


FIG. 1

Scotia shore, we have a mean range of 9.1 feet at Cape Sable, 14.0 feet at Yarmouth, 18.2 feet at Grand Passage, 24.1 feet at Digby Gut, 27.8 feet at Port George, 31.5 feet at Black Rock Light, 42.0 feet at Horton Bluff and 44.2 feet in Noel Bay.[5] At times of new and full moon, when the so-called spring tides occur, the range of the tide is about 14 per cent greater, and at such times the tides in Noel Bay have a rise and fall of about 50.5 feet.[6]

On the north shore a similar condition prevails, the range of the tide

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[4] Robert Chalmers: Report on the Surface Geology of Eastern New Brunswick, NorthWestern Nova Scotia. etc., Report M of *Ann. Rept. Geol. Survey of Canada*, Vol. 7 for 1894, Ottawa, 1895, p. 16.

[5] Tide Tables . . . 1922, p. 335.

[6] *Ibid.*, p. 335.

increasing from the mouth of the bay to its head. This increase becomes even more striking if we begin with the tide at Tom Nevers Head on Nantucket Island and go up the coasts of Massachusetts, New Hampshire, Maine, and New Brunswick, which form the western and northern shore of the Gulf of Maine and Bay of Fundy. For the mean range of the tide we have 1.2 feet at Tom Nevers Head, 3.7 feet at Monomoy Point, 6.0 feet at Nauset Harbor, 8.9 feet at Gloucester, 10.2 feet at Bass Harbor, 15.7 feet at West Quoddy Head, 20.9 feet at St. John, 26.3 feet at Quaco, 39.4 feet at

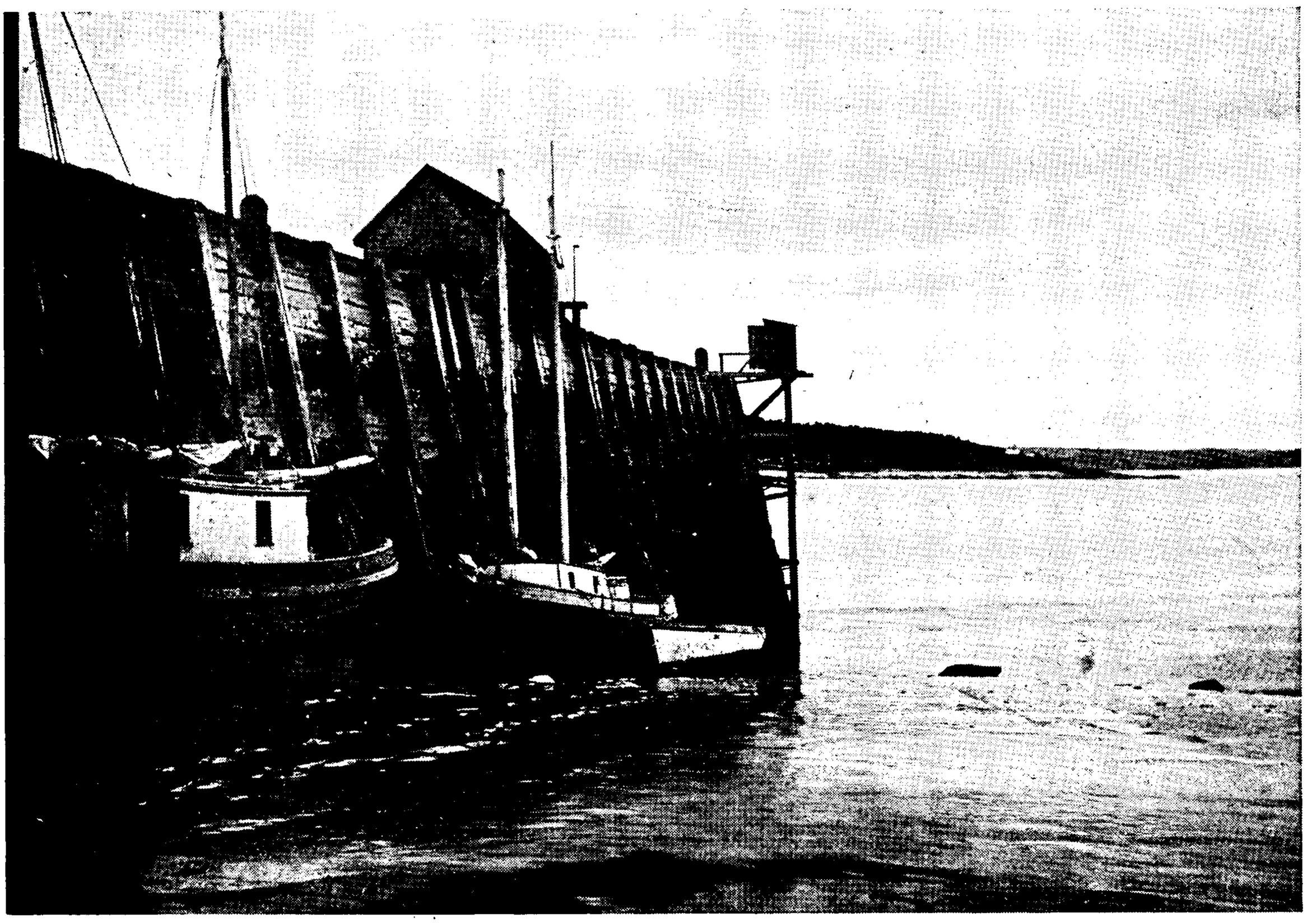

FIG. 2—Low Water, mouth of Petitcodiac River, Bay of Fundy. Government Wharf, Hopewell Cape. Folly Point seen in the distance. At spring tides the water falls about 13 feet lower than is seen here. (Courtesy of Canadian Tidal and Current Survey).

Folly Point, and 41.2 feet at Moncton.[7] Here likewise the spring range of the tide is about 14 per cent greater than the mean range.

It is evident that the effect of the converging shore lines and gradual slope of bottom tends to increase somewhat the range of the tide in the upper parts of the bay. But it is likewise evident that these features cannot be wholly responsible for the increase in range from less than 10 feet at the mouth to more than 40 at the head. There is involved some factor other than the "cooping up of the tidal wave as it advances up the bay." For in many other bays we have somewhat similar features without anything like corresponding increases in range of tide. Thus at the mouth of Delaware Bay we have a mean tidal range of 4.7 feet; and at Philadelphia,

[7] *Ibid.*, pp. 335–338.

where the cross section of the tidal waterway has decreased very considerably, the range of the tide is but 5.3 feet.[8]

A close examination of the ranges of the tide brings to light the fact that, relative to the axis of the bay, a point on the southern shore has a greater range of tide than the corresponding point on the northern shore. Thus the tide tables give as mean ranges of the tide 14.0 feet for Yarmouth against 12.9 feet at Starboard Island; 19.3 feet in Petit Passage against 15.7 feet at West Quoddy Head; 27.8 feet at Port George against 26.3 feet at Quaco.[9]

This increase in the range of the tide on the southern shore is brought about by the rotation of the earth, in consequence of which all moving bodies are impressed with a force deflecting them to the right in the northern hemisphere and to the left in the southern hemisphere. On the flood tide the water entering the Bay of Fundy is deflected to the right or southern shore; hence high water here is raised somewhat higher than on the northern shore. On the ebb tide the moving water is again deflected to the right; but now it is the northern shore that is to the right of the moving water, and hence low water is somewhat higher on the northern than on the southern shore. The tide therefore rises higher and falls lower on the southern shore, giving a greater range here than on the northern shore.

## Rate of Rise and Fall

In its rise and fall the tide does not move at a uniform rate. Beginning at low water the rise at first takes place very slowly but at a constantly increasing rate, so that about three hours after low water the tide has acquired its greatest rate of rise. From this time the rise begins to take place at a constantly decreasing rate until high water is reached. A similar cycle then begins in the falling direction, the rate of fall increasing gradually for about three hours, when it is greatest. The tide then continues its fall at a constantly decreasing rate until low water is reached.

If the rise and fall of the tide be represented graphically by plotting the height of the water at successive intervals of time, say every half hour or hour, the curve of the tide will approximate the well known form of the sine or cosine curve. This is brought out in the accompanying diagram of the rise and fall of the tide on August 13, 1862, at Eastport, Maine, on the northern shore of the Bay of Fundy. The curve was drawn by plotting the heights of the tide at every half hour as determined from an automatic tide gauge record.

The variations in the rate of rise and fall of the tide from low water to high water and from high water to low water stand out clearly in the diagram. The most rapid rise takes place midway between low water and high water, and the most rapid fall midway between high water and low water;

[8] Tide Tables . . . 1922, p. 344.
[9] *Ibid.*, pp. 335–336.

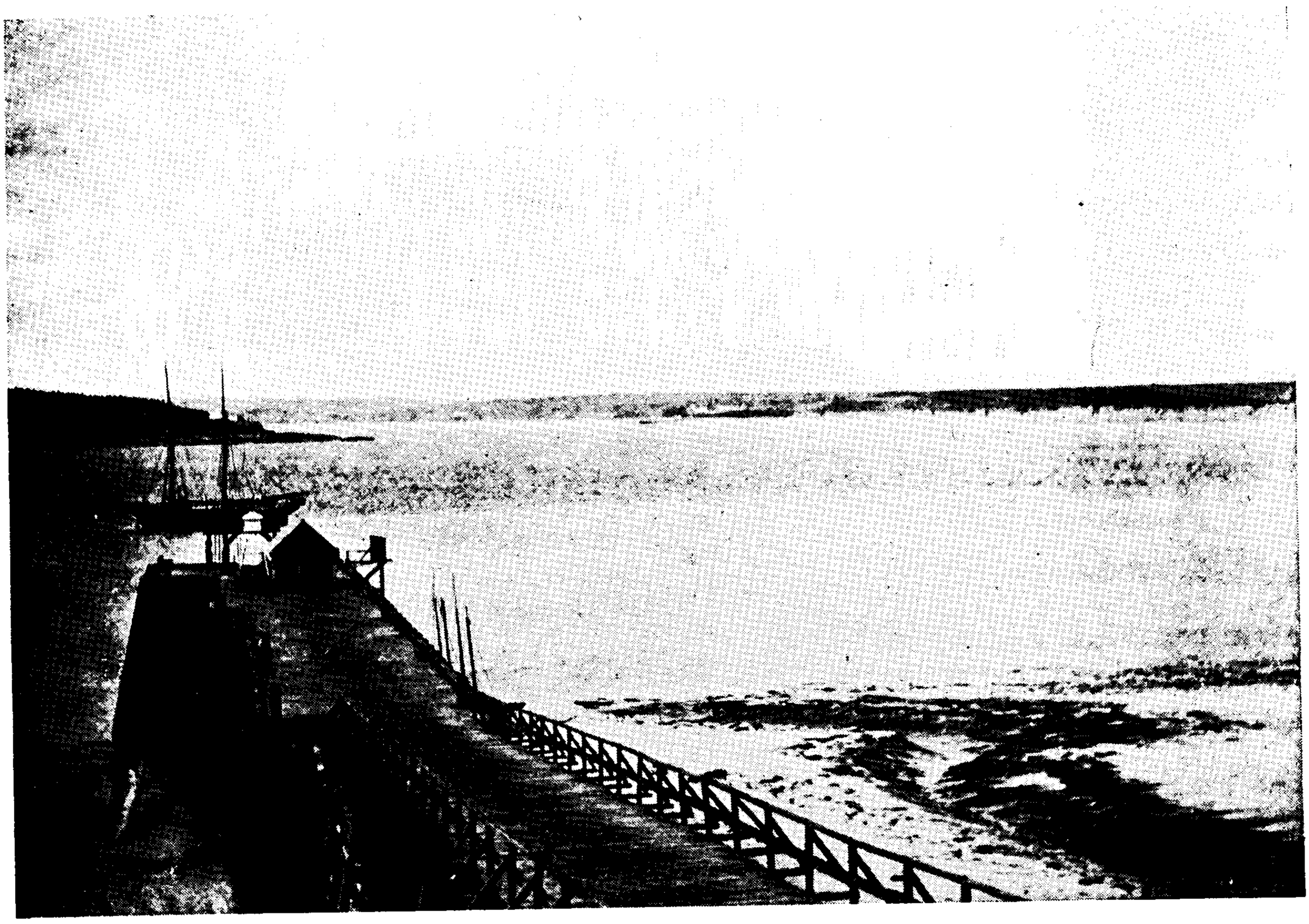

FIG. 3

FIG. 4

FIG. 3—Low water, mouth of Petitcodiac River, Bay of Fundy. Government Wharf, Hopewell Cape. (Courtesy of Canadian Tidal and Current Survey.)

FIG. 4—High water, mouth of Petitcodiac River, Bay of Fundy. Government Wharf, Hopewell Cape. High tide occasionally covers the wharf shown here. (Courtesy of Canadian Tidal and Current Survey.)

and in both cases this is about three hours from the time of high or low water.

From the theory of the cosine curve we find likewise that the most rapid change of elevation takes place midway between the highest and lowest points; and it is of interest to compare the theoretical rate of most rapid rise or fall with that determined from actual observations. From Figure 5 we find that from 7:40 A. M. till 1:45 P. M., that is in a period of 6 hours and 5 minutes, the tide rose a total distance of 21.1 feet, with the most rapid rise occurring between 10 and 11 A. M., when the elevation changed by 5.0 feet. For a range of 21.1 feet in six hours and five minutes, the theory of the cosine curve gives 5.4 feet as the greatest change in elevation during one hour. The close agreement between the actual rise of 5.0 feet and the computed rise of 5.4 feet for a true cosine curve shows that the tide curve for Eastport does not deviate much from the cosine curve.

The rate of rise or fall of the tide evidently depends on the total rise and fall of the tide, increasing in direct proportion to the total range. In 1916 in the vicinity of Noel Bay, W. Bell Dawson[10] measured a rise of 11.2 feet per hour occurring with a tide that had a total rise of 49.7 feet in a period of six hours and one minute. The theoretical most rapid hourly rise in a true cosine curve of the same range is 12.8 feet. In this connection it may be of interest to note that sixty years ago one of our encyclopedias had it that the Bay of Fundy was "remarkable for its extraordinary tides which rush up from the sea with such rapidity as sometimes to overtake swine feeding on shellfish on the shores."[11]

## Time of Tide

In most bays and rivers the time of tide becomes later, in going upstream, at a rate dependent on the depth of the tidal waterway. Thus in Chesapeake Bay the time of tide at Turkey Point Light, which is about 165 geographical miles above the mouth of the bay, is 12 hours later than at Cape Charles Quarantine.[12] This gives the tidal wave a rate of advance of 13¾ geographical miles per hour.

The relation existing between the time of tide in the upper and lower reaches of a bay, such as Chesapeake Bay or Delaware Bay, is given approximately by the formula, $v = \sqrt{gh}$ where $v$ is the velocity of the tidal wave, $g$ is the acceleration of gravity, and $h$ is the average depth of the tidal waterway. Applying this formula to the stretch of Chesapeake Bay from Cape Charles Quarantine to Turkey Point Light, we find, since the value of $g$ for the latitudes of Chesapeake Bay is 32.15 feet per second, a value for $h$ of 17 feet. This is an approximation to the average depth of that stretch of the bay.

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[10] Dawson, *op. cit.*, p. 10.

[11] New American Cyclopaedia, New York, 1858–1863, Vol. 8, p. 11.

[12] Tide Tables ... . 1922, pp. 345–346.

If we examine the times of tide in the Bay of Fundy we find a totally different state of affairs. While the time of tide becomes somewhat later in going upstream, this retardation in time is quite inconsiderable and has no such relation to the depth of the tidal waterway as given in the formula above. Thus from Machias Seal Island, near the mouth of the Bay, to Isle Haute about 77 miles upstream the difference in time of tide is but four minutes.[13] This gives a velocity for the tidal wave of 19¼ miles per minute, which, in the formula connecting the velocity of the tidal wave with the depth of the tidal waterway that holds good for most bays and rivers, gives the impossible depth of over 100,000 feet. The average depth of the bay from Machias Seal Island to Isle Haute is approximately 200 feet.

Throughout the whole length of the bay the time of tide differs but little. From Grand Passage to Noel Bay at the upper end, a distance of 132 miles, the tide becomes later by only 1 hour 39 minutes, giving for the tide a rate of advance of 1⅓ mile per minute, which in the formula connecting depth and velocity results in a depth of almost 600 feet.

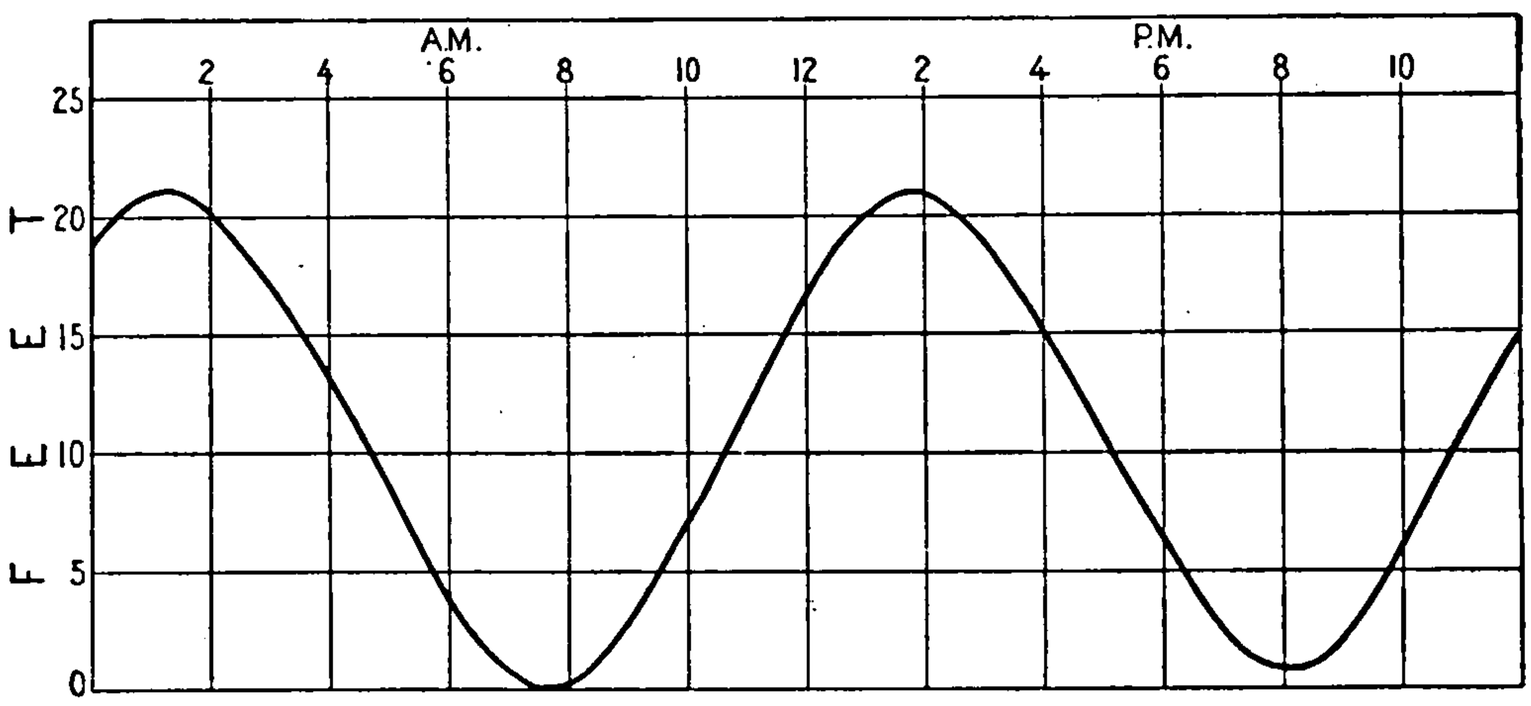


FIG. 5—Tide curve, Eastport, Me., August 13, 1862.

## RELATION OF CURRENT TO TIDE

In so far as the time of tide is concerned it is evident that the tidal movement in the Bay of Fundy is quite different in character from that obtaining in Chesapeake Bay and in most bays and rivers. Further light on the character of this tidal movement may be obtained from a consideration of the tidal currents that accompany the rise and fall of the tide. From low water to high water an enormous quantity of water passes from the sea into the bay; and in the fall of the tide from high water to low water this vast amount of water passes out again to the sea. We may therefore expect tidal currents having considerable velocities.

From observations made over a considerable stretch of the Bay of Fundy by W. Bell Dawson,[14] we find that the current stopped flooding about one hour after local high water and ebbing about an hour after low water. The strength of the flood current came about two hours before high water and the strength of the ebb current two hours before low water.

If we examine the relation obtaining between tide and current in a tidal

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[13] Tide Tables for the Eastern Coasts of Canada for the Year 1921, Canadian Tidal and Current Survey, Ottawa, 1920, p. 13.

[14] W. B. Dawson: Tables of Hourly Direction and Velocity of the Currents and Time of Slack Water in the Bay of Fundy, etc., Ottawa, 1908.

waterway like Chesapeake Bay, we find that the strength of the current comes about the time of high or low water and slack water about three hours before high or low water. Whereas in the Bay of Fundy the current was running swiftest about midway between high and low water, in Chesapeake Bay the current is slack at that time; and the relation obtaining between tide and current in Chesapeake Bay is the one that characterizes most bays and rivers.

## Types of Tidal Movements

The differences that distinguish the times of the tide and the relation of tide to current in the Bay of Fundy from those in Chesapeake Bay arise from the fact that the tidal movements in these two bays are of different types—illustrating, in fact, the two principal types of tidal movements.

In Chesapeake Bay it was seen that going upstream the tide became progressively later from place to place. This is the "progressive wave" type. From theoretical considerations of this type of movement it follows that the rate of advance of the tide is a function of the depth and that in a uniform channel the range of the tide tends to decrease in going upstream. Furthermore, the current that accompanies the rise and fall of the tide should have its greatest velocity about the time of high and low water, slack occurring midway between high and low water.

This progressive wave type of movement is illustrated on a smaller scale by the ordinary wind waves with which we are familiar along the coast and in inland waters. If for the moment we call the crest of such a wave high water and its trough low water, it is evident that when this wave travels over a body of water the times of high and low water will progress regularly from one end to the other end of the body of water.

A wave of a totally different kind may also be made to travel through a body of water. Suppose we have a vessel, say a rectangular tank, partly filled with water: if we raise and then immediately lower one end, a wave will be started which puts into oscillation the whole body of water. But it will be noticed that high water will occur at one end when it is low water at the other end and that, for the body of water as a whole, high water will occur simultaneously for one half at the same instant that it is low water for the other half. This kind of movement is known as the "stationary wave" type.

If we examine the simple stationary wave movement as exemplified in a rectangular tank of water, we notice that the rise and fall of the water is nil at the middle and greatest at the ends, the range increasing from the middle to the ends. Furthermore, the horizontal motion of the water ceases at the time of high water and is greatest midway between the times of high and low water. This is brought out in Figure 6, which shows in diagrammatic form the positions of the surface of the water at the instants of high water and low water at each end.

When the surface of the water is in the position indicated by the line A B, it will be low water for half of the tank from A to M and high water for the other half from M to B. And later, when the surface of the water has assumed the position C D, it will be high water from C to M and low water from M to D. At M therefore the water neither rises nor falls; and the extent of rise and fall increases with the distance from M, so that at the two ends the rise and fall is greatest.

From the characteristics of the tidal movement in the Bay of Fundy, it is evident that we have here an example of the stationary wave type, in which the bay behaves approximately as one half of the rectangular tank of water shown in Figure 6. From the mouth to the head the time of tide is nearly simultaneous, the rise and fall increasing with the distance from the mouth.

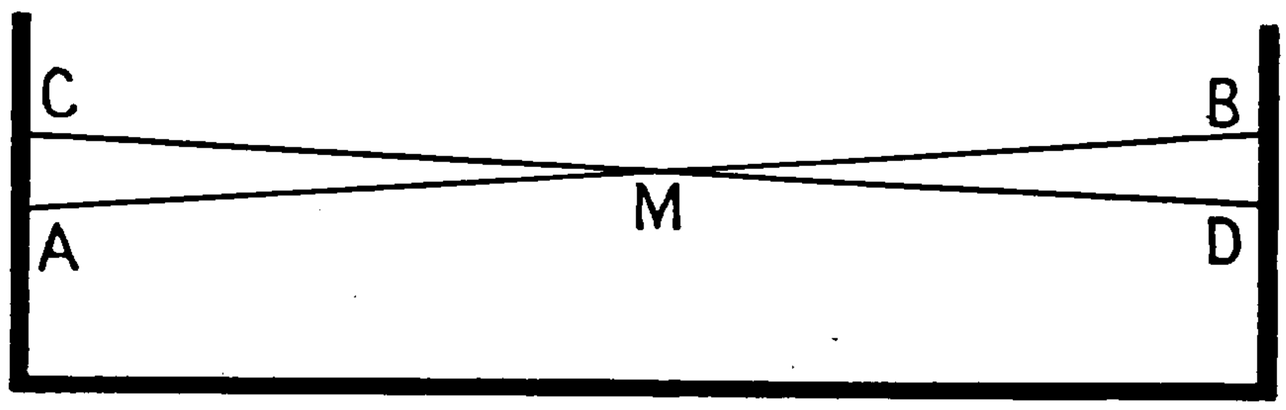


FIG. 6

A reason for the increased range of the tide in the upper reaches of the bay is therefore found in the character of the tidal movement. If we turn to other bodies of water in which the tidal movement is of the stationary wave type we shall likewise find an increase in the range of the tide from mouth to head. Thus in Long Island Sound, over the greater portion of which the tide is of the stationary wave type, the rise and fall of the tide increases from 2.0 feet at Montauk Point to 7.2 feet at Willets Point.

A further increase in the rise and fall of the tide at the upper end of the Bay of Fundy takes place because of the very considerable contraction in width and shallowing in depth. This increase in the range of the tide on account of decreased cross section takes place in both the stationary and progressive wave types of tidal movements. But even the co-operation of the causes adduced does not yet satisfactorily account for the enormous ranges of the tide found in the Bay of Fundy. A still further cause has been discovered somewhat recently in the period of oscillation of the water in the bay as a whole.

## PERIOD OF OSCILLATION

If we start stationary waves in tanks of various lengths filled with water to different depths, it will be found that the time taken for a wave to travel from one end of the tank to the other, that is the period of the wave, depends only on the length of the tank and the depth of the water. In other words, for each body of water there is a natural period of oscillation which is a function of the depth of the water and the length of the basin in the direction of oscillation; and, if it is desired to maintain the stationary wave movement in our tanks of water, it is only necessary to apply a slight force, at intervals, to the tanks. But it will be found that if the force is applied at regular intervals, the rise and fall of the water in the tanks will be con-

siderably greater; and if the force be applied to the different tanks at regular intervals which in each case coincide with the natural periods of the different tanks, we shall have the maximum rise and fall of the water in each tank.

In inclosed bodies of water the stationary wave type of movement has been known and studied under the name of "seiche" since the time of F. A. Forel,[15] who began his researches on the Lake of Geneva in the early seventies of the past century. The mathematical theory has been developed to a high degree, especially by Chrystal,[16] who has made it applicable also to irregularly shaped basins. But nothing had been done in regard to bodies of water opening at one end into a very much greater basin, as exemplified by bays connected with the ocean.

In 1908 there appeared, independently, two publications in which the oscillation of bodies of water open at one end was treated. R. A. Harris,[17] of the U. S. Coast and Geodetic Survey, investigated the matter in connection with his tidal studies; and, in Japan, Honda, Terada, Yoshida, and Isitani[18] were led to the investigation in connection with earthquake studies. From these investigations it developed that bodies of water opening at one end into larger basins are capable of sustaining stationary wave movements of the character exemplified by the movement of the water in half of the tank, Figure 6, the formula for the period of oscillation in a rectangular basin of uniform depth being approximately $T = \sqrt{\frac{4L}{g\,h}}$ where $T$ is the period of oscillation, $L$ the length of the basin, $g$ the acceleration of gravity, and $h$ the depth of water.

It would appear reasonable to suppose that the width of the mouth of a bay has some influence on the period of oscillation; and such in fact the Japanese investigators found to be the case. By introducing a factor to take account of the width of the mouth, the approximate formula above becomes more exactly

$$T = \sqrt{\frac{4\,L}{g\,h}}\sqrt{1 + \frac{2\,b}{\pi\,L}\left(0.9228 - \log_e \frac{\pi\,b}{4\,L}\right)}$$

where $b$ is the width of the mouth of the bay, $\pi$ and $e$ having the usual significance.[19]

It is evident that, in computing the natural period of oscillation of the Bay of Fundy, the length of the bay and also its width will vary in accordance with the limits assigned to the bay; and this in turn will affect the value of the mean depth of the bay. Thus Honda and his colleagues[20]

[15] Forel's studies are summarized in his "Le Léman," Lausanne, 1892–1904, Vol. 2, pp. 39–213.

[16] George Chrystal: On the Hydrodynamical Theory of Seiches, *Trans. Royal Soc. of Edinburgh*, Vol. 41, 1903–05, pp. 599–649.

[17] R. A. Harris: Manual of Tides, Part V, Appendix 6 of *Rept. of the Supt. of the Coast and Geodetic Survey for 1906–1907*, Washington, D. C., 1907, pp. 467–482.

[18] K. Honda, T. Terada, Y. Yoshida, and D. Isitani: Secondary Oscillations of Oceanic Tides, *Journ. College of Sci., Tokyo Imp. Univ.*, Vol. 24, 1908, pp. 1–110.

[19] See Otto Krümmel: Handbuch der Ozeanographie, Vol. 2, Stuttgart, 1911, p. 163.

[20] Honda, *op. cit.*, p. 106.

found that by taking the mouth of the bay from Cape Sable to Cape Cod and the end of the bay at Port Greville, the period of oscillation was 13.0 hours; while by taking the mouth from Yarmouth to Machias the period of oscillation came to 11.6 hours. Taking the bay as extending from Grand Manan Island to Sackville, Krümmel[21] derived a value of 12.46 hours. It is to be noted, however, that, while the value of the period of oscillation varies with the limits assigned to the bay, this value in every case approximates 12½ hours.

Now the mean value of the period of the tide is 12 hours 25 minutes, or 12.42 hours. We find, therefore, that the natural period of oscillation of the Bay of Fundy approximates very closely to the period of the tide. It appears, therefore, that the tides in the Bay of Fundy may be regarded as stationary wave oscillations of the whole body of water, the motion being sustained by the periodic ocean tide at the mouth of the bay. As we found in the case of our tanks of water, this oscillation is greatest when the period of the sustaining force is the same as the natural period of oscillation of the body of water.

It may, therefore, be concluded that the tidal phenomena in the Bay of Fundy are due primarily to the fact that the natural period of oscillation of the bay closely approximates the period of the ocean tide. This brings about a stationary wave movement with the greatest possible rise and fall of the water for the existing geographic features of the bay. In the upper reaches of the bay the range of the tide is further increased because of the considerable diminution of cross section brought about by the contraction in width and shoaling of bottom. The fact that some retardation in the time of tide occurs towards the head of the bay shows that there is some progressive wave movement present.

No account of the tide in the Bay of Fundy would be considered complete without at least a passing reference to the bore in the Petitcodiac River, at the head of the northern fork of the bay. Through a portion of this river the flood tide comes as a wall of broken and foaming water having "a height of perhaps two or three feet."[22] This striking phenomenon is brought about by the resistance offered to the incoming tide by the river current and by the shallow and contracted channel at low water. A careful description of the bore has been given by W. Bell Dawson.[23]

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[21] Krümmel, *op. cit.*, p. 319.

[22] W. B. Dawson: Survey of Tides and Currents in Canadian Waters, Ottawa, 1899, p. 23.

[23] *Ibid.*, pp. 22–25.

# THE FORESTS OF THE DOMINICAN REPUBLIC*

By WILLIAM DAVIES DURLAND

The visitor to the Dominican Republic who will forsake the historic towns and cities of the more populous seaboard for the less frequented highways and byways of the sparsely settled interior gains a profound impression of the country's forestal resources. Trees line the *Caminos reales* and extend in a mass of entangled foliage, vines, ferns, epiphytes, cacti, and tree trunks for miles and miles up the valleys and on the mountain slopes to the fern-clad summits of the highest altitudes. If the traveler come by way of Porto Rico this impression of luxuriant vegetation will be still deeper by contrast, for, though only 70 miles distant to the east, this densely populated island is very sparsely forested as the result of native waste and despoliation.[1] Least known of the Greater Antilles, Columbus's island of Hispaniola has been least changed since pre-Columbian times. At least 75 per cent of the land area is still forest-clad with trees that can be classed as timber. The area of the entire island is over 28,000 square miles, of which approximately two-thirds pertains to the Dominican Republic.

## PHYSIOGRAPHIC DIVISIONS

The republic in general presents a rugged appearance: mountain ridges of varying height separate rather extensive plains and enclose broad fertile valleys. In the northern part the ranges and valleys have a general west-northwest trend related to the trend lines of eastern and central Cuba; in the southern part the trend is east and west in line with the major axis of Jamaica. The relief is known only in broad and approximate outline; some parts of the country, indeed, are absolutely unknown. However, under United States supervision topographical and geological surveys have been begun and a tentative classification into physiographic provinces is available.[2]

The Cordillera Central, commonly known as the Sierra de Cibao, the principal mountain range, divides the country into two parts. It is described as a "jumble of ridges and peaks" whose extreme irregularity is to be explained by complex geological composition and structure.[3] Several peaks of the main ridge attain elevations of 8,000 and 9,000 feet. The Cordillera

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* Acknowledgment is made of the assistance of Professor H. N. Whitford, School of Forestry, Yale University, in the preparation of this paper and to Professor S. J. Record of the same school for identification of the wood samples collected by the author.

[1] L. S. Murphy: Forests of Porto Rico, Past, Present, and Future, *U. S. Dept. of Agric. Bull. No. 354* (Contribution from the Forest Service), Washington, D. C., 1916.

[2] T. W. Vaughan, Wythe Cooke, D. D. Condit, C. P. Ross, W. P. Woodring, and F. C. Calkins: A Geological Reconnaissance of the Dominican Republic (Geological Survey of the Dominican Republic, Memoirs, Vol. 1), Washington, D. C., 1921.

[3] *Ibid.*, p. 31.

Septentrional, or Monte Cristi range, follows the northern coast line from the base of the Samaná peninsula to Monte Cristi. The range is highest in the center north of Santiago where some peaks rise to elevations of 3,000 or 4,000 feet. The Samaná peninsula, which is considered a separate physiographic province, is also mountainous, reaching heights of 1,500 feet in the center. In the southwestern part of the republic the Sierra de Bahoruco extends from the province of Barahona into Haiti. The ridges with crest summits of 3,000 to 5,000 feet are intersected by valleys with local savanas. Two small ranges of hills, known as the Sierra de Martín García and the Sierra de Neiba, lie slightly further north, the former extending from the Caribbean Sea westward to the Sierra de Neiba, from which it is separated by the Rio Yaque del Sur. The Sierra de Neiba extends in a westerly direction into Haiti.

Between the central and the northern ranges lies the Valle del Cibao, the eastern portion of which, the Vega Real, is not only the largest and richest valley of the country but is described as "among the most impressively fertile districts in the world."[4] In the southern half of the republic similar but less extensive valleys lie between the various ranges, while in the eastern section between the main range and the sea are level regions that may be called plains. That part east of the Rio Jaina is known as the Seibo plain, or "Eastern Valley," a more humid region of forests and savanas; the western part is known as the plain of Baní and is drier, needing irrigation for its extensive crops. The plain of Azua is still drier, as is also the curious low-lying basin of Lake Enriquillo. Between the Sierra de Neiba and the central cordillera is the interesting Valle de San Juan, to be described later. Such is the abundant water supply of the country as a whole—a direct consequence of the high relief—that water for irrigation is almost everywhere plentiful. Except for one or two arid spots in the western portions it would be impossible to travel any distance in Dominican territory without encountering a stream or brook.

## Temperature and Rainfall

Although the Dominican Republic lies entirely within the tropics—approximately between latitudes 20° and 17° 30′ N.—the tropical climate is to a great extent tempered by the mountainous character of the country. In the lowlands of the coast the breezes cool the air the year round, blowing from the sea during the day and from the land after sundown: it is only the low, enclosed valleys that are excessively hot. Few actual meteorological records are available; in fact, on the entire island of Santo Domingo the only place from which a long continuous series of records is available is Port au Prince in the Haitian Republic. Port au Prince, however, is not far from the border, and the temperature regimen of that city may be taken as fairly typical, although the town because of its sheltered situation appears

[4] *Ibid.*, p. 29.

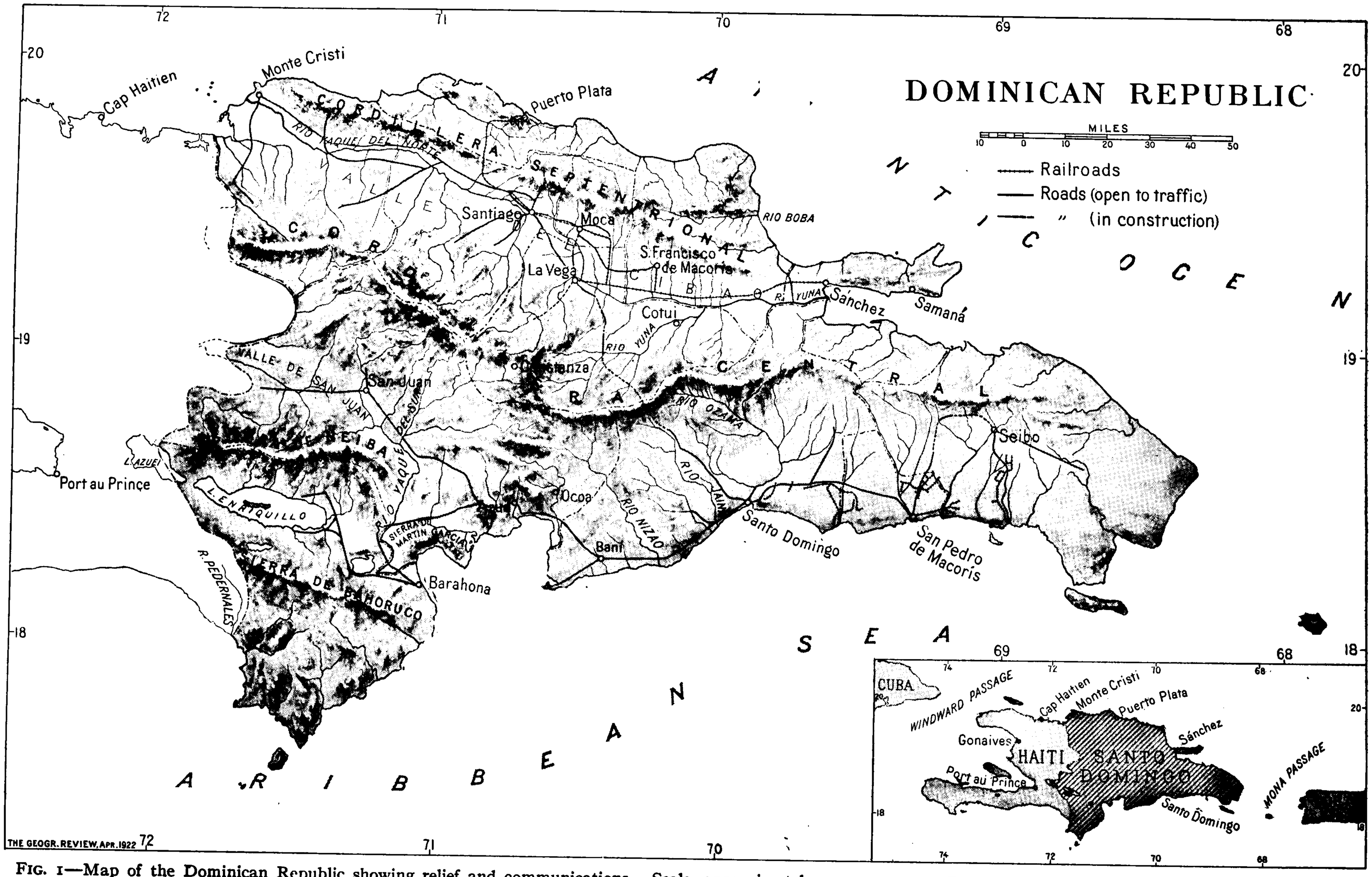


FIG. 1—Map of the Dominican Republic showing relief and communications. Scale approximately 1 : 2,750,000. The inset map shows the entire island of Haiti or Santo Domingo in relation to contiguous territory. Scale 1 : 11,000,000.

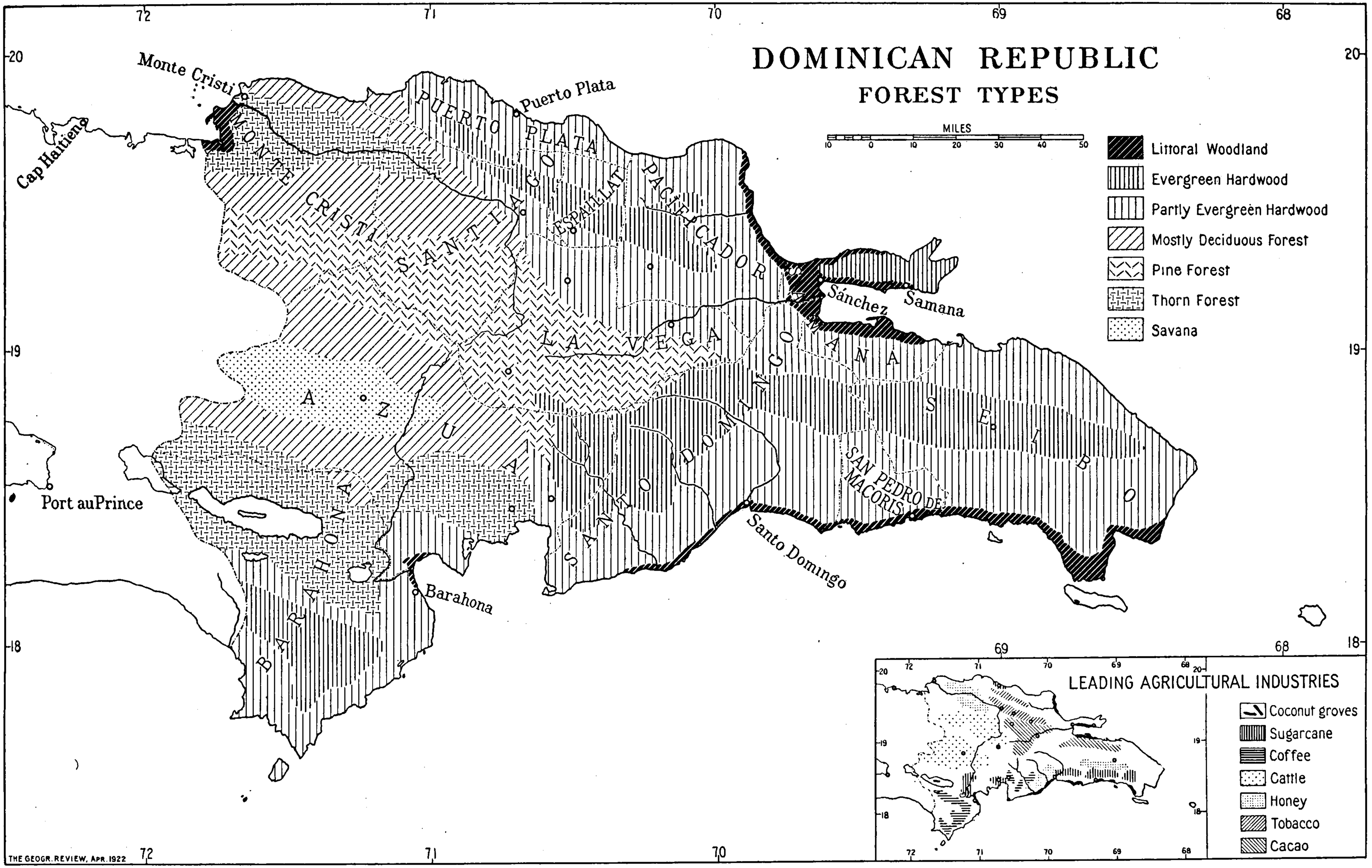


FIG. 2—Map showing the forest types of the Dominican Republic. Compare with the relief map (Fig. 1) opposite. Scale approximately 1 : 2,750,000. The inset map shows broadly the areas in which the chief agricultural industries are being carried on. Scale 1 : 11,000,000.

to be somewhat unduly hot. The mean annual temperature is 79° F., ranging from 82° in July to 75° in January, the mean maximum being 98° and the minimum 61°.[5] At Santo Domingo City where the U. S. Weather Bureau maintained a station from 1898 to 1900 the mean temperature was 77°, ranging from 80° in August to 74° in January and February, the absolute maximum being 95° and the minimum 59°.[6] Closely similar are the records for the three-year period (1886–1888) at Sánchez, Samaná Bay—mean 76.8°; range 80° to 73°.[7]

Two seasons, winter and summer, are usually distinguished, the distinction being in large measure a question of precipitation. From the month of March to October rains are usually abundant, and from November to February the season is generally known as dry. This is well illustrated in the cases of Santo Domingo City and Sánchez.[8] Points in the interior and

TABLE I—MEAN ANNUAL PRECIPITATION AT STATIONS IN SANTO DOMINGO

(*In inches*)

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Santo Domingo City (5 years) | 2.0 | 0.9 | 2.1 | 6.8 | 6.2 | 7.4 | 8.3 | 6.7 | 7.6 | 9.6 | 2.7 | 2.1 | 62.9 |
| Sánchez (7 years) . | 3.8 | 3.2 | 4.0 | 5.0 | 6.4 | 7.8 | 8.3 | 8.8 | 5.8 | 5.2 | 8.3 | 4.0 | 70 |
| La Vega (7 years) . | 4.6 | 3.6 | 3.3 | 5.6 | 7.6 | 6.8 | 7.2 | 4.0 | 4.8 | 6.8 | 10.0 | 2.8 | 67 |
| Port au Prince (39 years) . . . . | 1.1 | 2.3 | 3.7 | 6.5 | 9.7 | 4.1 | 2.9 | 5.3 | 7.5 | 7.0 | 3.5 | 1.3 | 55 |

the west show a tendency towards two rainy seasons. This tendency is apparent at La Vega and is well marked at Port au Prince. A number of observations from such a dry region as the lower valley of the Yaque del Sur show at least 20 inches of rain at every station. At Barahona the annual mean is 41 inches with two rainy seasons, April to mid-June and late September to the end of October.[9] On the northern coast of Santo Domingo, on the contrary, the winter months are the rainiest.[10] Differences of rainfall on windward and leeward slopes in conjunction with great topographic irregularity cause pronounced local variations in climate.

## THE GENERAL RELATIONS OF THE FOREST VEGETATION

Almost without exception the mountain ranges are covered with a forest growth and a sub-vegetation which together form a continuous canopy.

[5] Julius Hann: Handbuch der Klimatologie, Stuttgart, 1910, Vol. 2, p. 353.

[6] Observations quoted by Otto Schoenrich: Santo Domingo, New York, 1918, p. 128.

[7] Hann, Vol. 2, p. 348.

[8] C. E. P. Brooks: The Rainfall of San Domingo, *Meteorol. Mag.*, Vol. 56, 1921, pp. 73–74. [Rainfall at stations in the eastern half of the Cibao Valley.]

[9] T. W. Vaughan, etc.: A Geological Reconnaissance of the Dominican Republic, p. 197.

[10] See the statistics of rainfall at Puerto Plata and at points on the northern coast of Haiti in *Bull. Ann. de l'Observatoire Météorologique du Séminaire-Collège St. Martial*, Port au Prince, Haiti.

As a whole, these forests are very similar in character and composition to other tropical forests of the Antilles. Compared with Porto Rico and Cuba their resemblance is very close, with the exception of the pine forest which seems to have gained a superior foothold in the Dominican Republic.

Concerning the forest vegetation of this republic very little is known from a technical standpoint. It is evident that for many years the properly called "gold nuggets" of the forest have been cut out by dyewood and cabinet-wood seekers, both native and foreign, and the qualities of these woods are exceedingly well known. Satinwood, mahogany, fustic, logwood, ebony, pencil cedar, and lignum-vitae are the better known of these woods, and they have been exported in considerable quantity since trade first began with the republic. Outside of these well-known woods of commerce and a few others, there is very little knowledge to be had concerning the scientific identity and the technical uses of the remaining species of the forests. Hand specimens of a number of the native Dominican woods have been collected, and the identity of some of these has been established. A more or less complete list of the tree species to be found in the republic is included in the appendix to this article. At the present time there is great need for a botanical exploration of the forests.

All who are acquainted with the general character of tropical forests are aware that from the standpoint of the botanist they are exceedingly complex in composition. Contrasted with the temperate regions the great majority of the species are woody—either trees or woody vines. Furthermore, the tree species of the forests, because of their inherent tendencies, usually arrange themselves into successive stories or floors of varying and irregular heights which differ from the type of forest in which they are growing. Where the climatic and soil factors approach the best conditions for forest growth, the lower story is composed of tree species whose crowns, when mature, form the first story; towering above this at more or less regular intervals are the crowns of the species which go to make up the second story. The uppermost stories include the tallest trees of the stand and contain, comparatively speaking, fewer species than either of the first two stories.[11]

The writer has prepared a forest-type map showing the broad relations of the forest vegetation, and a general discussion of this map is to be found on the succeeding pages. The information upon which the construction of this map is founded was secured by numerous reconnaissance surveys over the entire republic extending throughout a period of nearly two years. It was collected en route from place to place over established trails; and as such it is, at best, only general. All the type division lines are more or less arbitrarily established, as no location measurements were taken. Accordingly there exists a wide variation between the actual and the platted locations of these types. The inset agricultural map is based on information collected during the same surveys; and, as such industry is correlated with

[11] Compare H. N. Whitford: Forest Conditions of Colombia and Venezuela, *Bull. Pan Amer. Union*, Vol. 6, 1918, pp. 468–483.

forestry, it is included herewith. It is hoped that, notwithstanding its summary character, the map will serve as a nucleus around which a more systematic investigation of the forest resources of this republic will be made.

The forests of the Dominican Republic represent, according to the climatic and the edaphic-physiographic factors which have influenced their composition, the fundamental types established by ecologists with their corresponding divisions and gradations. They are as follows:

1. Evergreen Hardwood Forest
2. Partly Evergreen Hardwood Forest
3. The Pine Forest
4. The Thorn Forest
5. The Savana
6. The Mostly Deciduous Forest
7. The Littoral Woodland

## The Evergreen Hardwood Forest Type

The evergreen hardwood forests occupy the zones of greatest rainfall. They cover (1) the eastern half of the upper slopes of the Cordillera Central, from the head of the Vanilejo and Nizao Rivers, eastward to the termination of the range on the seacoast in the province of Seibo and (2) the upper slopes of the Cordillera Septentrional, from the headwaters of the Saledo and Juba Rivers, southeastward to the vicinity of the Gran Estero and the upper reaches of the Boba River. This type of forest is also characteristically developed in the peninsula of Samaná, where the rainfall is heavy and more evenly distributed through the year than in some parts of the country. The central part of the province of Barahona, which embraces the upper slopes of the Sierra de Bahoruco from the higher elevations southeast of the city of Barahona to the headwaters of the Pedernales River, is also covered by this forest. Because it flourishes here on the upper slopes and hence under more temperate climatic conditions there is some modification of the distinctive tropical characteristics of the evergreen lowland forest of more torrid regions. There is a gradual reduction in the wealth of tropical forms and a decrease in the extent and development of many specifically tropical peculiarities—large-leafed foliage, planked buttresses, woody lianas and epiphytes, with storied under-forests of varying heights.

The individuals of these forests, as the classification indicates, are evergreen hardwoods which are hygrophilous in character. Collectively they are rich in thick-stemmed lianas and epiphytes and contain a wealth of aerial roots which descend vertically and unbranched through the air from the tree crowns. One of the striking features of these trees is the mosaic coloring of the bark, resembling that of the beech of the north temperate zone. The temperature and moisture conditions are more or less uniform throughout the year, extending the actual growing period of the species

within this type over the entire twelve months. It is here, as would be expected, that the most luxuriant forest growth of the republic is found. Within these forests there is displayed a dense mass of foliage from the ground up to the tops of the tallest trees, beneath which there is scarcely any direct sunlight and through which it is exceedingly hard to make one's way. Indeed this particular type of foliage is so dense that it is impossible, as has actually been proved by airplane observation, to see through it.

The composition of this forest is very complex; and, because of its location and the moist condition of its habitat, neither of which are favorable for any extensive exploitation of the forest, it is the least known. With the decrease in temperature attendant on an increase in altitude on ascending the mountain slopes, the characteristic stature of the composite species decreases in size. The majority of the species in this zone range in diameter from 10 to 25 inches. Very few larger trees are found here, whereas on the warmer lowlands, under proper conditions of moisture, the trees often reach a size of 36 inches in diameter and over.

FIG. 3—Evergreen hardwood type. An individual, showing the planked buttresses and the mosaic appearance of the bark resembling our northern beech.

Other descriptions of tropical rain forests of similar altitude in the islands and mainland borders of the Caribbean apply very well to the conditions found within this type.

## THE PARTLY EVERGREEN HARDWOOD TYPE

In general the partly evergreen hardwood type represents the transitional stages of the forest growth between the typical evergreen hardwood type and the mostly deciduous type. In the case of the Dominican Republic, however, where owing to extreme topographic irregularity the diversity of climate over the entire forested area is great, this type appears rather as an independent formation than as a transition form. The type resembles to

some degree the monsoon forest of Schimper. Such transition forms have been described by Pittier for Panama and Venezuela.[12]

Compared with the evergreen hardwood type the tree life, because of climatic and soil differences, is much more varied. The temperature is higher and more uniform throughout the year. There is a seasonal change as regards the occurrence of precipitation, whence the numerous deciduous species present in the type composition. The forest is more or less open, occupied here and there by small rolling savanas or grasslands, many of which are probably due to the activities of man. There is a wide variation in the plant growth forms from gnarled, deformed shrubs or dwarf trees to lofty individuals, true giants of the vegetable kingdom. In places the trees are found in groups or small groves resembling the wood lots of our native pasture lands.

This type of forest occupies large areas but differs from the evergreen hardwood forests in being confined to the lower elevations between the mountain ranges and the seacoasts. It extends from the lower slopes of the Cordillera Septentrional and the Sierra de Bahoruco inland for a short distance, where it more nearly represents the transition stage mentioned above. This type practically surrounds the evergreen hardwood forest of the three largest ranges and occurs in a more or less continuous belt following the outline of the republic.

Much of the surface covered by this type has been cut over that the land might be used for agriculture. Many of the areas so cleared and cultivated according to the primitive methods of the *conuqueros* have long since been abandoned. Especially is this the case in the provinces of Santo Domingo, San Pedro de Macorís, and Seibo where, next to the valley of the Cibao, the population is the densest in the republic.

Many natural savanas also occur within the type, and it is often difficult to distinguish between these and the artificial openings made by man.

In the southwestern part of the province of Santo Domingo, lying wholly within this zone, particularly on calcareous soils in the valleys of the Ozama, Jaina, and Nizao Rivers and their tributary streams near the seacoast, are found large quantities of mahogany. Dominican mahogany is said to be excelled by none as to color, quality, and adaptability to fine furniture and cabinet work. Less of this wood is now secured than formerly. Considerable quantity of logwood was previously obtained also, but the supply today is practically exhausted. A fact worthy of note is the effort that is being made to produce a second growth of mahogany. Every farm, both large and small, within the area is protecting the young trees with the hope that they will bring a profit to their owners.

Many edible fruit-bearing species, undoubtedly introduced and planted by man, together with the highly utilized palms which find conditions best

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[12] See for example H. Pittier: Our Present Knowledge of the Forest Formations of the Isthmus of Panama, *Journ. of Forestry*, Vol. 16, 1918, pp. 76–84; and Esbozo de las formaciones vegetales de Venezuela, Caracas, 1920, of which an abstract appears elsewhere in this *Review*.

FIG. 4

FIG. 5

FIG. 6

FIG. 4—Evergreen hardwood type. A stand of cigua and cabilma on the La Vega-Santo Domingo highway This timber is equal to any American hardwood in quality.

FIG. 5—Evergreen hardwood type. Forest in the vicinity of Guananito, province of Santo Domingo. The first and second storied trees have been removed as the first step in clearing the land.

adapted for their growth within this type also, are prominent in its present composition.

From the standpoint of the lumberman this forest is better known than the one previously described because it supports the growth of many of the heretofore much-sought-for "gold nuggets" of the tropics.

## The Pine Forest Type

The pine forest of the Dominican Republic is of more interest commercially than all of the other forest types put together. This can be explained perhaps by the fact that pine lumber has long been used and is well-known, chiefly because foreign pine has been extensively imported for general construction purposes. The species is resinous and heavy, barely floating in water. In past years a few attempts have been made to exploit this pine, but operations have been on a small scale and of a temporary nature. The still unsettled status of land ownership[13] and the previous unstable conditions of the native government have made exploitation as a business enterprise practically impossible, whence the lack of development of what is considered to be a domestic source of construction lumber and the unmolested condition in which this pine is found.

The boundaries of the pine forest are usually sharply defined. As a type it occupies the northern slopes of the main range from the vicinity of Cotui west to the Haitian border. Botanically the formation is not complex, 80 per cent and over of the surface area being covered by one species of pine identified as *Pinus occidentalis*. In appearance the type somewhat resembles the open parklike stands of pine in our own southern states though it is far less abundant per acre. It ranges in diameter on the average from 12 to 25 inches breast-high and in total tree height from 40 to 60 feet. Eggers reports that at the higher elevations (4,000 feet) individuals approaching 200 feet in height and 4 feet or more in diameter are not uncommon.[14] The trees are scattered more or less singly over the area in a very open manner, on the ridges in particular. They are found at times, although exceptionally, in dense pure stands. A luxuriant growth of wild grass over which cattle graze at will forms a ground cover beneath the pine. This ground cover is coincident with the occurrence of the pine and is characteristic of the type. A good picture of the pine forest landscape is given by Gabb in his description of the Constanza Valley on the southern border of the pine zone.

> There is not a spot in Santo Domingo less tropical in appearance than the Valley of Constanza. The settlement of a dozen houses is in the midst of the woods. There is not a palm, plantain, or other tropical-looking plant in sight. The frowning black mountains, shutting in the valley on all sides; the tall columns of the pine trees, with the prostrate trunks and yet solid stumps of their fallen brethren; the little houses, encircled with split rail-fences and bargates; the browsing cattle, horses, and sheep, and above all the crisp morning air, so cold as

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[13] Compare F. R. Fairchild: The Problem of Santo Domingo, *Geogr. Rev.*, Vol. 10, 1920, pp. 121–138.

[14] H. Eggers: Reise in das Innere von St. Domingo, *Petermanns Mitt.*, Vol. 34, 1888, pp. 35–41; reference on p. 36.

to condense one's breath into visible vapor, all point rather to the heart of the Sierra Nevada than to the interior of an island under the Cancer.[15]

The pine type is not found at all in Porto Rico. In Cuba it has a limited distribution occurring on certain rugged peaks of the Sierra Maestra at elevations not less than 1,800 feet above sea level.[16] The existence of the pine forest on such an extensive scale in the Dominican Republic is attributed to the simple operations of the *conuqueros* with their primitive methods of agriculture.[17] The continual cutting and burning of the original forest growth, which probably was an evergreen or partly evergreen hardwood

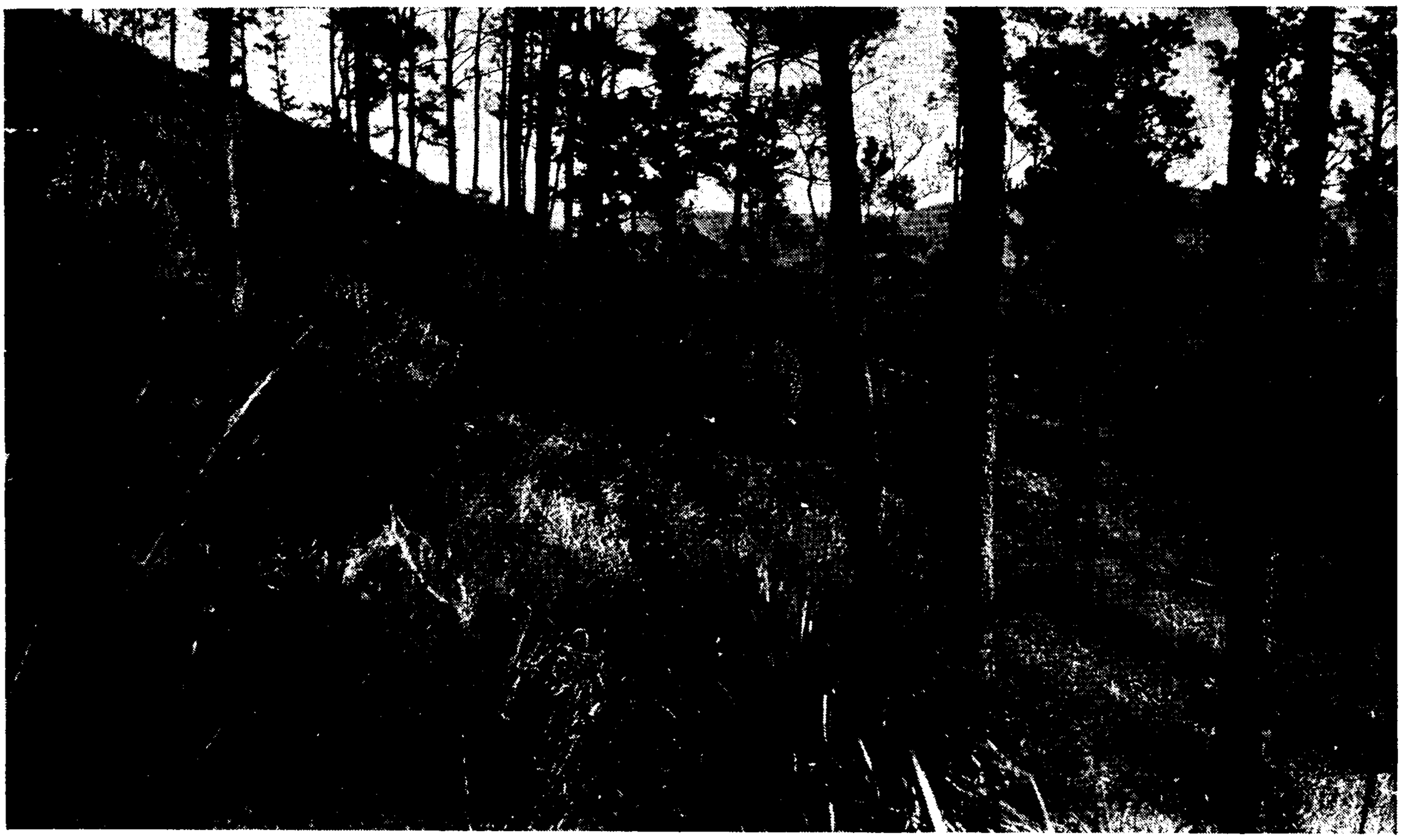

FIG. 7—A pine-clad slope in the vicinity of Jarabacoa, southwest of La Vega.

type, has destroyed the fertility of the soil to such an extent that it will no longer support the growth of these vegetative types. As a consequence the pine has been permitted to enter, perhaps from a lofty habitat where it naturally occurred on a small scale. In the absence of any competition and having the inherent capacity for growth on such soil, the pine has thrived and reproduced. The soil which practically supports the entire growth of pine is a reddish clay, or laterite, a fact which has been noted by Gabb.[18]

Evergreen and partly evergreen hardwood species mixed with pine are found in small, dense, thicket-like patches at the heads of many draws and in secluded valleys. The soil of these particular localities, in contrast to the laterite of the more exposed slopes and ridges, is composed of a dark rich

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[15] W. M. Gabb: On the Topography and Geology of Santo Domingo, *Trans. Amer. Philosophical Soc.*, Vol. 15 (N. S.), 1872–80, pp. 49–259; reference on p. 133.

[16] B. E. Fernow: The High Sierra Maestra, *Forestry Quart.*, Vol. 4, 1906, pp. 239–273.

[17] O. F. Cook: Vegetation Affected by Agriculture in Central America, *U. S. Dept. of Agric. Bull. No. 145.*

[18] W. M. Gabb: Notes on the Distribution of the Vegetation of Santo Domingo, *Amer. Journ. of Sci.*, No. 102, Ser. 3, Vol. 2, 1871, pp. 127–129.

fresh loam. On such sites the pine, although a minor species in the composition, grows to a larger size and is a more healthy and vigorous tree.

## Thorn Forest Type

Schimper states that "thorn woodlands are also richly developed in the Antilles." Similar types of vegetation have also been found in definite regions of the Dominican Republic where it is described by Harshberger as chaparral.[19] The great Cibao valley becomes progressively drier as one goes westward. A critical point is reached a little west of Santiago where the forest type of the Vega gives place to thorn forest. As the name indicates, this formation contains many species of trees and shrubs strongly armed with needle-like and piercing spines and prickles, so finely attached and arranged for defensive purposes that they seem to fly at one whenever within striking distance. The scenery has been compared with that of Lower California.

FIG. 8—The main street of a typical town of the Dominican Republic. The sides of the houses are made from boards cut from the highly utilizable palm.

The resemblance of this region to the arid plains of Lower California is very striking. The same dry soil covered with a scanty carpet of grass, the same low, straggling-limbed, open-foliaged acacia-trees: the same tall columnar cactus, with its undergrowth of *opuntias;* even the same cloudless sky, make the likeness complete.[20]

Another hot and semiarid area of thorn forest is found in the southwest, extending from the Bay of Neiba and including the plain of Azua westward through Haiti and including the depression of Lake Enriquillo. The gradually falling surface of this salt lake is now 144 feet below sea level, and the barrenness of the surrounding area is due rather to the salinity of the soil than to the scantiness of rainfall. Throughout the thorn-forest regions, in fact, the rainfall is not so scanty as the vegetation suggests, but most of the rain falls in the form of torrential showers, and the benefits from this precipitation are practically entirely lost through run-off. The soil composition has been found to be very desirable for agricultural purposes, but artificial irrigation is necessary. Lignum-vitae, logwood, and fustic are included in the valuable products of the thorn-forest regions.

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[19] J. W. Harshberger: Phytogeographic Survey of North America, *Die Vegetation der Erde*, Vol. 13, 1911, p. 681.

[20] W. M. Gabb: On the Topography and Geology of Santo Domingo, *Trans. Amer. Philosophical Soc.*, Vol. 15 (N. S.), 1872–80, pp. 49–259; reference on p. 157.

## The Savana Type

The name of this formation usually implies grasslands intermingled with isolated plants and trees and an herbaceous growth, chiefly noticeable during the dry season of the year when it contributes a brownish, dried-up appearance to the landscape. The interior valley of San Juan which is more or less level and open, resembling a plain or prairie, presents such characteristics and is indicated on the vegetation map as comprising this type of formation. About 50 miles of the valley, which extends into Haiti, lies in the Dominican Republic and it is 10 to 12 miles wide. The soil is fertile, and there is more water for irrigation than in the adjacent plain of Azua; but this savana, rich in pasture land with a natural growth of succulent grasses and other herbaceous ground cover, is primarily devoted to cattle raising. Cattle are raised in almost every part of the republic; but in this valley, with San Juan as its chief commercial center, the industry is most favorably supported by the natural growth of the region and exceeds any development elsewhere. As in the case of the other types, detail information regarding the vegetation is lacking. However, as the Spanish name implies, it is not a timber-producing type, and the real forest vegetation other than shrubs and bush is widely scattered and of no significance in the general character of the formation.

## The Mostly Deciduous Type

The savana type of the San Juan valley is encircled by a belt of tropical forest distinct in character from either of its bordering neighbors. It occupies an elevation corresponding to the low-lying range of hills known as the Sierra de Neiba, which naturally separates the formations mentioned, and the southern slopes of the western part of the Cordillera Central. At the most westerly end of the northern range or Cordillera Septentrional and surrounding the thorn forest in the northwestern part of the republic there is a similar forest type. Both are classified as mostly deciduous forests. The temperature of these areas is, on the whole, high and more or less uniform throughout the year. The climate is semiarid, the rainfall being limited and seasonal. The species of these forests are for the greater part xerophilous in structure and occur in a mixed type of vegetation which as a whole has drought-resisting characters. The information at hand is too inadequate to describe it in detail. It could very easily be included with the partly evergreen hardwood type although the deciduous species occur far more abundantly in the type under discussion.

## Littoral Woodland Type

Two distinct types are here presented, as is the case with other littoral woodland formations of the Antilles and Central America. They are (1) the mangroves, or tidal woodlands, and (2) the woodlands above high-tide mark.

These types are formations of the tropical seashore and vicinity and are

characterized by the fact that the fruits or seeds of the composite species have, as a rule, devices which enable them to float. Mangroves and coconut groves are found in greatest abundance within this belt, which is confined to narrow strips along the seacoasts of the eastern and southern part of the republic, broken here and there by protruding headlands of higher elevations and by other areas unadapted to the support of such growth. The mangroves are found in the delta regions of the Rivers Yaque del Norte, Yuna, and Yaque del Sur.

## Conclusion

Such are the forestal resources of the Dominican Republic. Commercially the bulk of the forests is unexploitable at present because of the unfamiliarity of the world markets with the exact nature of the woods, but as they become better known the real value of these forests will be more appreciated. Although the republic is greatly behind the times in its industrial and commercial development, it has a decided advantage over the neighboring islands in having maintained its forests in almost a natural state. But, if this wealth is to remain a permanent asset, measures must be taken to control the destruction that has already begun. The commonly known system of "conuco making," which is directly responsible for destruction of the forest, has placed Porto Rico in an undesirable economic position in respect of timber resources; and, should it continue in the Dominican Republic, that country will suffer the same fate—many devastated areas and a scarcity of wood for even the most humble of domestic uses. Any forester will grant that agriculture is a higher use of the soil and that it is of more fundamental importance to the development of a nation than the preservation of the forest trees; but to sacrifice one for the temporary progress of the other is more detrimental than beneficial. In the vicinity of Maniel (San José de Ocoa) particularly, acres and acres of cleared land that have served a temporary progress of providing a few scanty crudely cultivated agricultural crops, and that have long since been abandoned, are but a few examples of what is taking place over the entire forested area of the Dominican Republic. Such clearings are on a small scale, to be sure; but with increasing population will come increasing destruction, for the people as a whole are purely agricultural. An attempt has already been made to correct the destructive tendency and to further the utilization of the forests. A continuance of this policy is necessary if the republic is to maintain its present enviable position as regards timber resources.

## Appendix

The following list contains some of the tree species previously referred to in this article. Specimens of these woods were collected under the name used locally in the Dominican Republic and were brought to the United States for study and deposited with the collection of tropical woods at the School of Forestry, Yale University. In most cases it has been possible to establish the scientific identity of the species, and in such instances the technical name is listed with the common name. No detailed study, however, has as yet been

made of these specimens, and hence only the better-known of the species have been identified. There is a possibility that the local classification differs in different parts of the republic. By a preliminary examination of the specimens and by comparing them with other known woods of tropical and semitropical countries, together with the application of such knowledge concerning similar woods as is available, the following scientific nomenclature has been determined. In some cases identity was not established beyond the family name.

No attempt has been made to correlate the species with the vegetative types established, because of insufficient information concerning their distribution. In general, however, the majority of these tree species occur in the partly evergreen hardwood type at elevations between sea level and 1,000 feet.

Baitoa, caoba, cedro, espinillo, mora, guayacán, campeche, and sabina are the more important woods of commerce. Baitoa is used in connection with the manufacture of scientific apparatus as a boxwood; caoba is the true mahogany of commerce; cedro is considered an excellent wood for cigar boxes and other containers of tobacco products; espinillo is known on the market as satinwood; mora is commercial fustic which is a source of vegetable dye; guayacán is lignum-vitae, especially desirable for use as brush bearings in ship propellers; campeche is the logwood of commerce, a source of vegetable dye frequently known as haematoxylon stain, and sabina is eagerly sought for as a desirable wood for the manufacture of high grade pencils.

All of these woods are exported from the republic in varying quantities. For the most part they are more valuable as products for export than for local consumption.

Bayahonda, candelón, capa prieto, capa de sabana, and calla blanca are woods which are almost entirely used locally, chiefly for railroad ties, native sugar-mill rollers, ox-cart hubs, and wheel spokes. Hoja ancha is purchased by the government in natural tree lengths for telephone poles. Pichipin is made into saw lumber, but to a very limited extent, and is all readily consumed in the immediate vicinity of the small mills. Almácigo is said to make very desirable wood pulp for high grade paper manufacture.

Aguasero
Alfiler (*Betulaceae*)
Almácigo (*Bursera gummifera*)
Amacei, copaiba (*Copaifera officinalis*)
Ausubo (*Myrtaceae*)
Baitoa (*Phyllostylon brasiliensis*)
Bayahonda (*Calliandra formosa*)
Cabilma (*Cedrela angustifolia*)
Calla blanca
Calla colorada (*Sapotaceae*)
Campeche, logwood (*Haematoxylon campechianum*)
Candelón (*Colubrina ferruginosa*)
Caoba (*Swietenia mahogani*)
Capa de sabana (*Petitia domingensis*)
Capa prieto (*Cordia gerascanthus*)
Cedro (*Cedrela* sp.)
Ceiba, silk-cotton tree (*Ceiba pentandra*)
Chicharrón (*Chicharronia intermedia*)
Cigua (*Lauraceae*)
Coquito (?)
Corbana (?)
Daguilla, or la guilla (?)
Escobón (*Myrtaceae*)
Espinillo, satinwood (*Zanthoxylum* sp.)
Espino ruvial (*Rutaceae*)
Granadillo (*Gymnanthes lucida*)
Guaconejo (*Amyris silvatica*)
Guasumilla (?)
Guayacán, lignum-vitae (*Guaiacum officinale*)
Higuerillo (?)
Hoja ancha (*Myrtaceae*)
Laurel (*Lauraceae*)
Malagueta (*Sapotaceae*)
Mangle blanco (*Laguncularia racemosa*)
María, or Santa María (*Calophyllum calaba*)
Membriyo (*Cerasus occidentalis*)
Mora, fustic (*Chlorophora tinctoria*)
Nisperillo (*Sapotaceae*)
Olivo (?)
Ozua (*Myrtaceae*)
Pichipin (*Pinus occidentalis*)
Quebra hacho (*Dipholis nigra*)
Roble blanco (*Tecoma pentaphylla*)
Roble prieto (*Catalpa* sp.)
Sabina (*Juniperus* sp.)
Saona (?)
Sapotillo (*Sapotaceae*)
Sinaso (?)
Yaya (*Cordia* sp.)

In the following list are other tree species that the author has seen growing in the Dominican Republic. Those tree species which have the same local, or common, name as is contained in a list of Dominican trees by D. José Ramon Abad have been correlated with the common names of the tree species as they are known to the author, and the scientific identity as established in the former case is included herewith. The better known of these little-known woods are mangle rojo (or colorado), divi-divi, lana, and ébano. Mangle rojo supplies a tanbark. Considerable quantities of this bark are shipped annually, principally from the port of Sánchez. Divi-divi produces a bean which furnishes a valuable dye. This product has, however, in recent years become practically exhausted. Lana produces a vegetable wool which at certain seasons of the year is collected by the natives, baled, and exported. Ébano is the ebony of commerce and is exported in limited amounts. Javillo, known in some foreign markets as possumwood, is found in varying quantities, but as yet none has been exported.

Some of the listed tree species produce edible fruits at certain seasons of the year. Of these algaroba, almendrón, guanabano, and caimitillo are the most important.

Acana (*Acrasia* sp.)
Aceituno (*Aextoxicon punctatum*)
Algaroba, W. I. locust (*Hymenaea courbaril*)
Almendrillo (*Pommus occidentalis*)
Almendrón (*Terminalia catappa*)
Bera, or vera (*Bulnesia arborea*)
Cabo de hacha (*Trichilia spondiodes*)
Caimitillo (*Chrysophyllum oliviforme*)
Cañafístulo (*Cassia fistula*)
Caobilla de costa (*Croton lucidus*)
Caucho (*Castilla elastica*)
Chácara (*Coulteria fistula*)
Cochinilla (*Comocladia integrifolia*)
Cocuyo (?)
Copey (*Clusia rosea* and *alba*)
Divi-divi, or guatapana (*Caesalpinia coriaria*)
Ébano de Santo Domingo (*Brya ebenus*)
Espino (*Zanthoxylum lanceolatum*)
Guanabano (*Artabotrys palustris*)
Guara (*Cupania americana*)
Guaraguao (*Bucida capitata*)
Guaraguao, or cacao (?)
Guayacancillo (*Guaiacum verticale*)
Higo (*Ficus* sp.)
Higuera (*Crescentia cujete*)
Jagua (*Genipa americana*)
Jagüey (*Ficus* sp.)
Javillo, possumwood (*Hura crepitans*)
Jia (*Casearia alba*)
Jobos, hog plum (*Spondias* sp.)
Juan prieto (?)
Juan primero (?)
Lana (*Bombax pyramidale*)
Limoncillo cimarrón (*Pimenta pimento*)
Mangle rojo, or colorado (*Rhizophora mangle*)
Nogal (*Juglans jamaicensis*)
Palo amargo (*Ceanothus americanus*)
Palo blanco (*Tecoma leucoxylon*)
Palo de leche (*Brosimum galactodendron*)
Palo de tabaco (?)
Palo muñeco (*Quassia amara*)
Péndola (*Catalpa* sp.)
Tarana (?)
Vara de lazo (?)
Yagua (*Varronia alba*)

# GEOGRAPHICAL RELATIONS IN THE DEVELOPMENT OF CUBAN AGRICULTURE

By R. H. WHITBECK
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Cuba, the last of the independent nations that have sprung from the wreck of Spain's colonial empire in the New World, began its separate national existence in 1899. Its rapid progress and material prosperity cause it to stand out among the Latin American states. In 1920 the island, whose area is only about that of the state of Pennsylvania, had a part in international trade greater than that of Brazil and nearly three times as large as that of Spain. The high ranking of Cuba in this year, due in large measure to the high price of sugar at the time, is an indication of the vast importance of Cuba's principal product. In the fiscal year of 1920 the island sold to the outside world products valued at $850,000,000, and 91 per cent of this was sugar. For the calendar year of 1920 the exports amounted to $573,000,000. The falling off was almost wholly due to the decline in the price of sugar.

Cuba holds first place among the cane-growing countries of the world, though it has risen to this commanding position only recently. Cuban sugar production did not reach a million tons a year until 1895, shortly before the end of Spanish rule. Since Cuba attained independence and its relations to the United States became closer, sugar production has nearly quadrupled. There is no other independent country so completely devoted to a single industry as Cuba is to sugar. The life of the island centers around this product. Everywhere men talk sugar; it dominates politics and finance, and its price determines activity in every line of business. The sudden drop in price in 1920 was a stunning blow to Cuba, and the whole financial system of the nation staggered under it. The abounding prosperity which had nearly amounted to intoxication suddenly came to an end, and the ensuing financial strain brought the island to the verge of collapse.

This dominance of sugar is peculiarly the outgrowth of the island's geographical position, coupled with its endowment of fertile soil and level land. These features will be considered in relation to the development of this and other subordinate resources of the island.

## THE HIGH PROPORTION OF AGRICULTURAL LAND

While Cuba is a part of the Antillean mountain system, it has been largely reduced to fertile plains.[1] Only in the eastern quarter is the island dis-

[1] For a condensed account of the geology see M. L. Fuller: Notes on the Hydrology of Cuba, *U. S. Geol. Survey Water-Supply Paper 110*, pp. 183–199. For a more complete account see "Report on a Geological Reconnoissance of Cuba" made to General Leonard Wood by Hayes, Vaughan, and Spencer, and published in 1901.

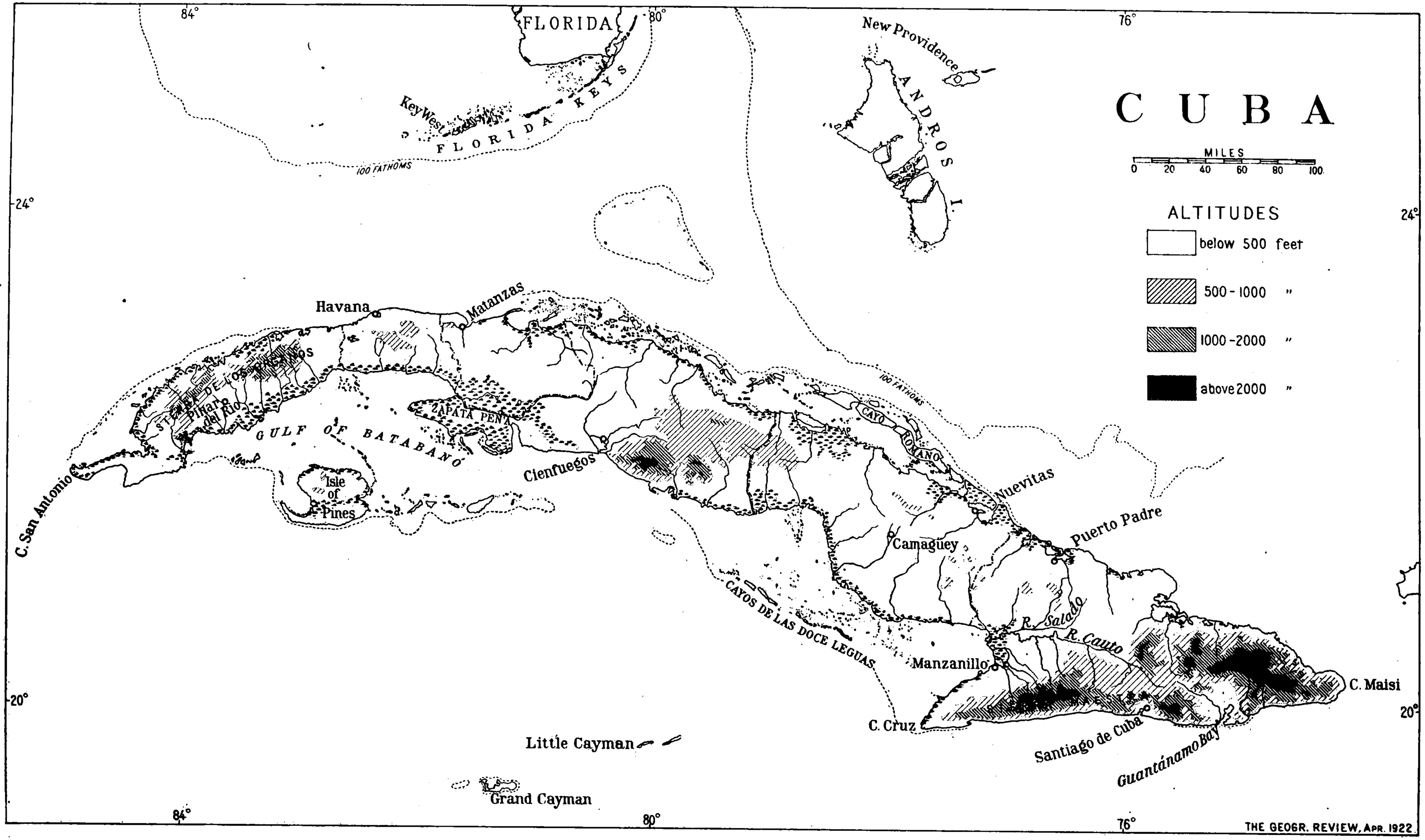


FIG. 1—Map of Cuba showing relief. Scale approximately 1: 6,600,000.

tinctly mountainous, and the total mountainous area does not exceed one-fifth.[2] The Sierra Maestra range, close to the southern shore of Oriente, rises to elevations of nearly 9,000 feet. This is the most wild and undeveloped part of Cuba, yet a great deal of the province is made up of fertile valleys and gentle slopes. One valley, that of the Cauto, 100 miles long, is the most pronounced valley in the island and is very fertile. In recent years the largest increase in sugar plantations and sugar mills in any part of Cuba has been in Oriente.

A low range of mountains—the Sierra de los Organos—attaining heights of 2,500 feet, extends parallel to the northern coast in Pinar del Rio, the westernmost province. However, the nearly level plains of this province exceed the area of the mountains and include the most valuable tobacco land of Cuba, the Vuelta Abajo district west of Havana. A few other groups of low mountains and occasional spurs exist near the southern coast and near the northern coast, but they are neither long nor high. Of these the most picturesque are the Trinidad Mountains near the southern coast in the province of Santa Clara. One extensive swampy area, the peninsula of Zapata, occupies a strip 60 miles in length and 25 in width on the southern coastal plain west of Cienfuegos. The rest of Cuba, and the major part, is made up of level or nearly level lands sloping gently from an almost indiscernible water-parting extending lengthwise of the island. Contrary to the showing on many maps, no mountain chain extends east and west through the middle of Cuba; the trunk railroad of the island traverses this middle line. Over 80 per cent of Cuba is actual or potential agricultural land, and 10 per cent more is equal in quality to land that produces crops in Java, China, and Japan. Cuba could, if necessary, grow more sugar cane than all the world now produces.

## The Great Fertility of the Soil

The ancient land of Cuba was submerged beneath the sea for geological periods of great length and was buried beneath a thousand feet or more of sediments, the greater part of which is limestone. Two-thirds of the island is still covered by this limestone, deeply disintegrated. In places the younger rocks have been entirely denuded, and the masses of ancient crystallines project through the sedimentary beds like islands rising above the sea.[3] The limestones are honeycombed with caves, some of them—as, for instance, the caves of Bellamar in Matanzas—are famous for their extent and beauty. Many streams disappear into the ground and perhaps reappear; while over large areas there is no surface drainage whatever. The

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More recent data are contained in "Contributions to the Geology and Paleontology of the Canal Zone, Panama, and Geologically Related Areas in Central America and the West Indies," *U. S. Natl. Museum Bull. 103*, Smithsonian Instn., Washington, D. C., 1919. An account of the physiography and stratigraphy of Cuba and the Isle of Pines by Dr. Vaughan of the U. S. Geol. Survey is promised for forthcoming publication.

[2] R. T. Hill (Cuba and Porto Rico with other Islands of the West Indies, New York, 1898) estimates the mountainous area at one-fourth.

[3] J. W. Spencer: Geographical Evolution of Cuba, *Bull. Geol. Soc. of Amer.*, Vol. 7, 1896, pp. 67–94.

residual loams, both red and black, are derived from the age-long disintegration of the limestones and have the characteristic fertility of such soils. Though parts of Cuba have been cropped for four hundred years, very little of the sugar land is artificially fertilized. The cane yield per acre is larger than in almost any other region of America and larger than in Java or India but only half as large as in the irrigated lands of Hawaii.

## The Many-Harbored Coast

Cuba rests upon a submarine platform which is much larger than the island itself. Over this platform the waters are shallow, and coral growth is abundant. A barrier of coral islands or reefs—said to be 570 in number—parallels a part of the northern coast, and an even larger number (730) are scattered along the southern shore.[4] Nearly everywhere the coast is abrupt and clifflike. Along much of the northern coast and along the southern coast of the province of Oriente, rock terraces, rising one above the other, are conspicuous features. At least six of these are recognizable near Matanzas east of Havana,[5] and eight occur near Santiago, the highest being 400 feet above the sea.[6] These terraces plainly represent successive uplifts of the land, the uplift being greatest at the eastern end of the island. Further evidence of these uplifts is seen in the young valleys and gorges carved in the floors of the older valleys. These are especially noticeable from the railroad as one rides through the province of Oriente.

A low divide occupies the main, or east-west, axis of the island, and numerous short rivers flow either to the north or to the south except in the mountainous province of Oriente. At the mouths of the rivers land-locked harbors occur, numerous and excellent. As Hill says, "They are so conveniently situated as regards different portions of the island that the trade of Cuba may be said literally to pass out at a hundred gates."[7] Almost every one of the harbors has a characteristic pouch shape—a narrow entrance opening into a broad bay (Fig. 2). The uniformity in the shape of these harbors on both sides of the island suggests that they are due to a common cause. Havana, Cienfuegos, and Santiago—the most important harbors of Cuba—are all similar. The harbor of Nuevitas (Fig. 2) on the northern coast is a good example of these peculiar pouch-shaped bays of Cuba. The entrance to this harbor is only one-sixth of a mile wide in the narrowest portion and broadens as you proceed from the sea to the inner bay, which is eight miles broad. At the narrowest place in the entrance the water is over 100 feet deep but is much shallower in the broad part of the inner bay. Clearly this deep narrow channel connecting the ocean with the broad inner bay is a young valley cut by a stream through the

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[4] R. T. Hill, *op. cit.* p. 36.

[5] J. W. Spencer, *op. cit.*

[6] T. W. Vaughan and A. C. Spencer: The Geography of Cuba, *Bull. Amer. Geogr. Soc.*, Vol. 34, 1902, pp. 105–116; reference on p. 113.

[7] R. T. Hill, *op. cit.*, p. 86.

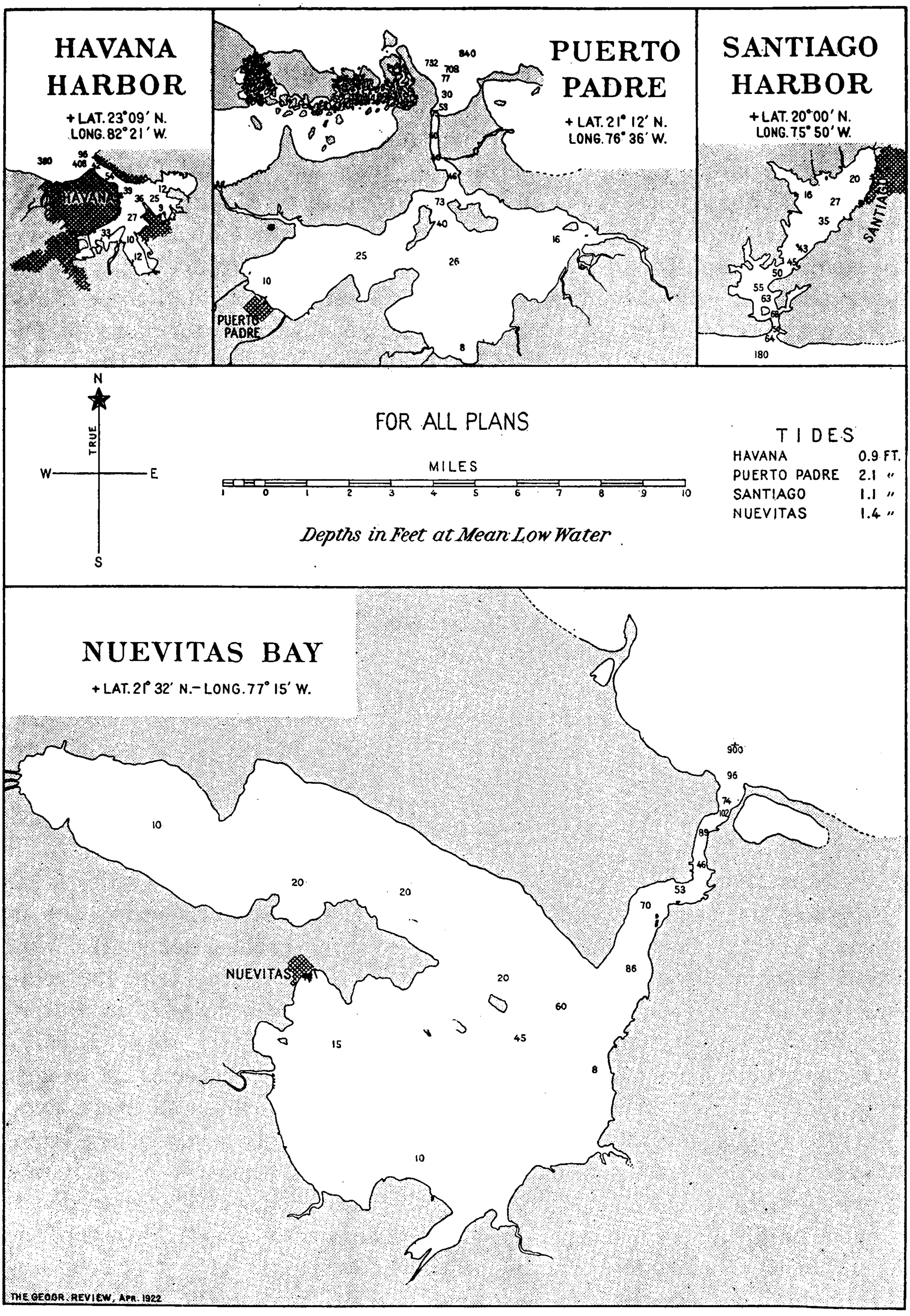


FIG. 2—Examples of the characteristically pouch-shaped harbors of Cuba. The four maps are drawn to the same scale and are based on U. S. Hydrographic Charts, Harbor of Habana (No. 307), Port Padre (No. 1970), Santiago Harbor (No. 1856), Nuevitas Bay (No. 1883).

younger rock formation along the shore; tidal currents may have aided. The youngest part of the entrance channel is the part nearest the ocean, and this fact suggests strongly that the successive uplifts of the coast lands have been gradual enough to permit the river and the tidal currents to maintain a channel across the rising coast strip of coral reef or other rock. The steplike terraces which are so common along the Cuban coast prove the successive uplifts, and the shape of the harbor entrances—narrowest at the seaward end—indicates that the most youthful parts of these channels are at the outer or seaward ends. The notable depth of many of the harbor entrances seems to indicate a recent moderate sinking of the coast. That the pouch-shaped harbors are drowned drainage basins is the theory held by Hayes and Vaughan, who find a particular demonstration of the validity of the theory in present conditions along the Yumuri River near Matanzas. "The river here empties into the sea through a narrow gorge cut through Miocene limestone and marls . . . Above the gorge, the Yumuri and its tributary, Rio Caico, have sunk their courses through the limestone, have removed it, and have developed wide, almost base-level valleys on the underlying softer sandstone and shale. If this basin were depressed sufficiently to let the sea into it through Yumuri gorge a pouch-shaped harbor would result."[8] The number of such harbors on both coasts and their excellence greatly facilitate the exportation of the enormous sugar crop, preventing the congestion which must occur if only a few ports were used.

## The Cuban Climate[9]

The outstanding features of the temperature of Cuba are the uniformity throughout the year and from year to year. The three warmest months at Havana average only 10° warmer than the three coolest, while the difference at Santiago de Cuba is only 5° or 6°. Contrast this with the temperatures at Galveston which vary from 83.3° in summer to 55.6° in winter, or 27.7°. The highest recorded temperature in Havana is 100.6° in July, 1891; and the coldest is 49.6° in February, 1896. The temperature in any given month varies little from year to year. The difference in mean temperature between the warmest and coolest recorded July is less than 2°, and between the coolest and the mildest January is less than 6°. Snow is unknown, and frost is known only in the higher altitudes. There is also a marked uniformity of temperature throughout the island (disregarding the influence of altitude in the mountainous sections). This is largely due to the equalizing effect of the surrounding ocean and to the fact that the long axis of the island extends east and west rather than north and south.

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[8] T. W. Vaughan: Fossil Corals from Central America, Cuba, and Porto Rico, etc., *U. S. Natl. Museum Bull. 103*, pp. 189–524; reference on p. 284. A fuller discussion of the Cuban harbors is promised in a forthcoming paper.

[9] The data used in the section on climate are taken for the most part either from official publications of the U. S. Weather Bureau or from "El Clima de Cuba" by Mariano Gutiérrez-Lanza, *Proc. 2nd Pan Amer. Sci. Congr., Dec. 27, 1915, to Jan. 8, 1916*, Vol. 2, Section 2, Astronomy, etc., Washington, D. C., pp. 132–172.

The rainfall cannot be called heavy, and there is wide variation between years of maximum and of minimum precipitation. On the northern coast the average annual rainfall is 50 inches; on the southern coast, 45 inches; and in the interior, 60 inches. Distribution has a distinctly seasonal character—a "dry" season of about five months (December to April) and

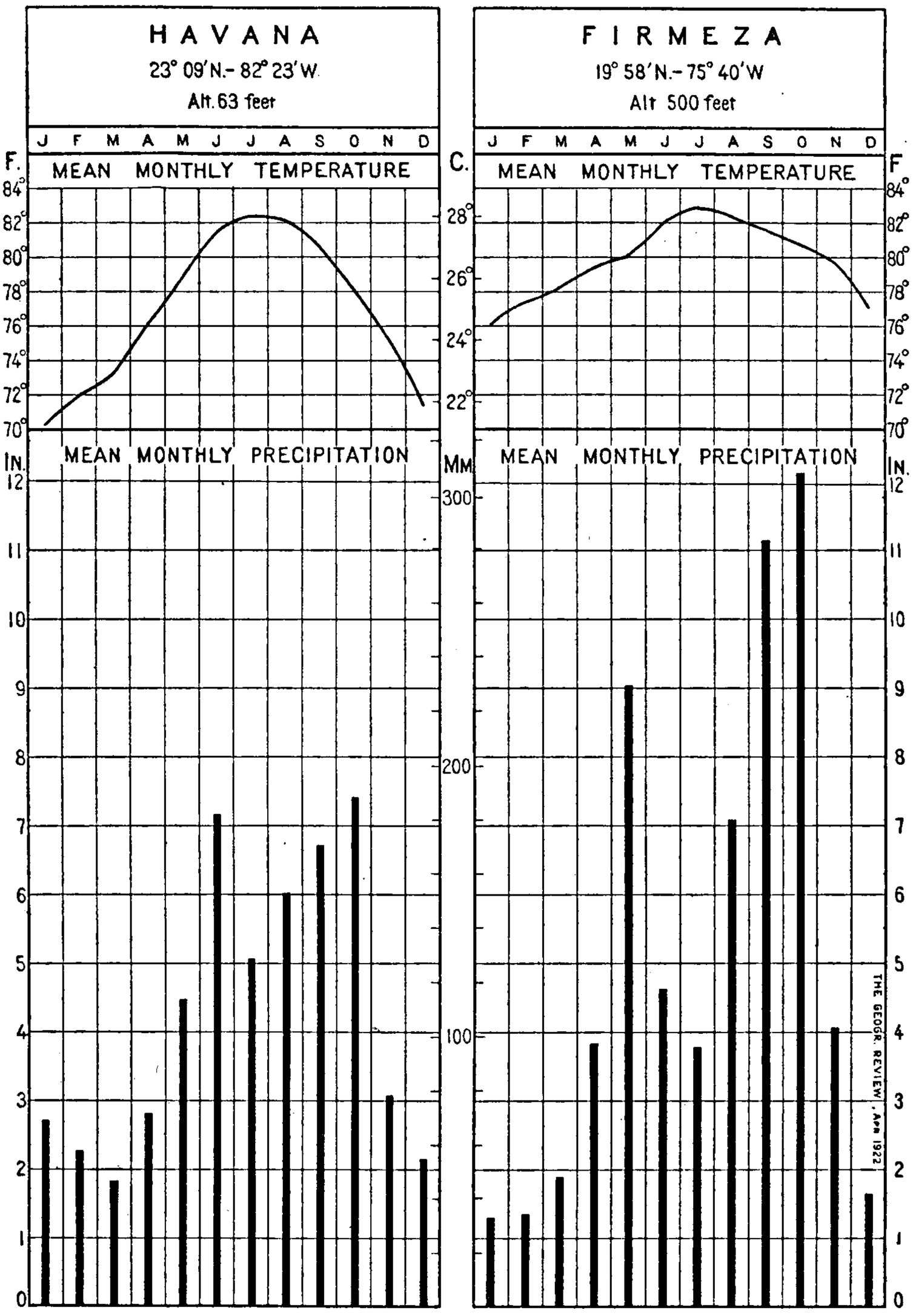


FIG. 3—Graph showing the mean monthly temperature and rainfall at Havana and Firmeza (near Santiago). The higher land of the eastern end of the island has in general the heavier rainfall. Data from the Annual Report of the Chief of the U. S. Weather Bureau, 1897–1898.

a "wet" season of about seven months (May to November). Over a period of 30 years the precipitation during the wet months ranged from 22 inches to 49.5 inches in Havana, and from 8.8 to 33 inches during the dry months. The heaviest rainfall comes in September and October, months of low atmospheric pressure and hurricanes in the Caribbean region. The heavy rainfall of May is plainly due to a secondary low pressure period occurring at that time.

Rains are of the tropical downpour type; 6 inches of rain have fallen at Havana in 24 hours, and 13 inches at Firmeza near Santiago on the

southern coast. Showers are three times as frequent in the afternoon as in the forenoon; they are soon over, and sunshine returns quickly. Relative humidity is remarkably uniform from season to season, averaging about 75 per cent in Havana through the year in the dry season and wet season alike.

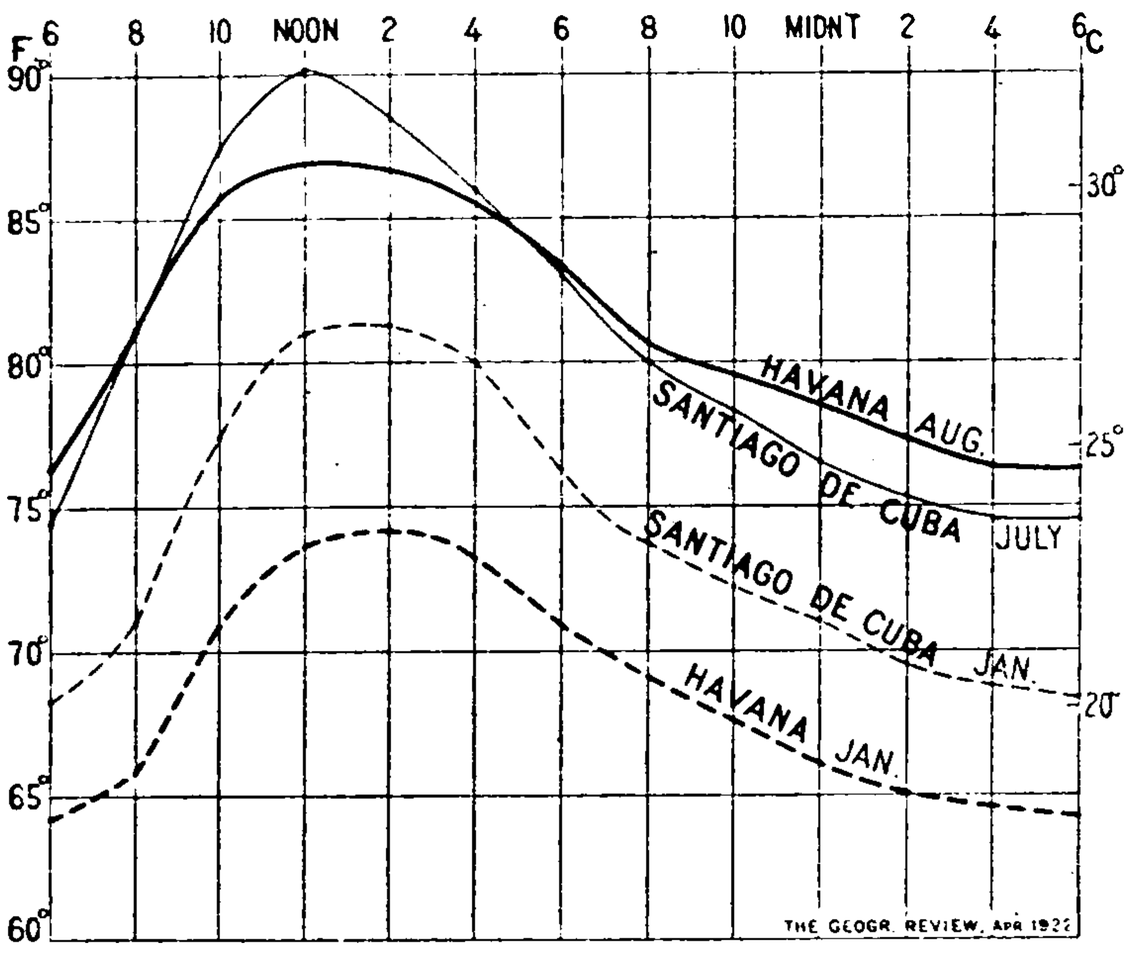


FIG. 4—Graph showing the daily march of temperature in the warmest and coolest months of the year at Havana and Firmeza. Data from the Annual Report of the Chief of the U. S. Weather Bureau, 1897–1898.

Cuba is in the belt of trades throughout the year and there is relatively little difference in the strength or direction of the winds from month to month. Tropical hurricanes are occasional but not frequent; of 22 such storms occurring in the West Indies and studied by the U. S. Weather Bureau, only 7 crossed Cuba. The diurnal variation in velocity is pronounced however. Thus at Havana the wind, which has an average velocity of 4.3 miles an hour at 4 A. M., increases to a maximum of 11.4 miles an hour at 2 P. M., diminishing to 5.6 at 10 P. M.[10]

TABLE I—NUMBER OF DAYS PER MONTH ON WHICH RAIN FELL AT HAVANA

(*Data for 35 years*)

| | JAN. | FEB. | MAR. | APRIL | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minimum | 1 | 1 | 1 | 0 | 3 | 4 | 7 | 9 | 7 | 7 | 5 | 3 |
| Mean | 8 | 6 | 6 | 5 | 9 | 13 | 13 | 13 | 15 | 15 | 10 | 8 |
| Maximum | 14 | 13 | 10 | 9 | 16 | 21 | 20 | 21 | 25 | 22 | 16 | 16 |

Such are the more salient features of the Cuban climate. As regards relation to the most important crops of the island note should be made of the following points: (1) Freedom from frost—permitting sugar cane to grow year after year without replanting; (2) a hot, rainy season ideal for the growth of cane; (3) a season of light rainfall, suited to the harvesting of sugar cane, which is injured by wetting after it is cut, unless promptly ground; (4) freedom from extremes of temperature; (5) a climate suited to white occupation and much relieved by cool nights and by the trade winds which, strengthening in the afternoon coincidently with increasing temperature, afford a delightful unfailing breeze that takes away much of the oppressiveness of the tropical heat. On the whole, Cuba has a climate that is ideal for vegetation and not ill suited to the maintenance of an energetic race.

[10] *U. S. Weather Bur., Rept. of the Chief, 1897–98*, p. 314.

## The Forests

Originally Cuba was largely but not entirely forest-covered. In 1899, when the first careful census was taken, it was estimated that 27 per cent of the area was covered with large timber and 14 per cent with small timber; a part of the latter was presumably new growth on lands formerly under cultivation. Thus, in 1899, 41 per cent of the island was forested, and the major part of this was in the eastern end of the island. Clearing is still in progress, for the newly cleared ground affords the most productive cane land. The census of 1907 gives the following distribution of forests by provinces: Oriente 520,000 acres, Santa Clara 308,000 acres, Pinar del Rio 148,000 acres, Matanzas 113,000 acres, Camaguey 88,000 acres, Havana 49,000 acres. Evidently these figures include only forests containing merchantable timber, for the total, 1,220,000, is less than five per cent of the land area of the island, and certainly four or five times this area is covered with forest growth of some sort. Occasional glowing accounts of the great wealth of mahogany and cedar in Cuba are only partially true.

## Agriculture

In early colonial days cattle raising was the chief occupation of the colonists, and it has remained an industry of importance down to the present time. The latest enumeration indicates that there are nearly 4,000,000 cattle in the island, a considerable proportion of which are oxen used as draught animals. A large proportion of the cattle ranges are in the province of Camaguey. Every sugar plantation has many oxen, in some cases reaching into the thousands; they do nearly all of the work of plowing, harrowing, and hauling. They feed upon the stripped-off leaves of the cane and are sleek and fat in the harvest season. The beef animals are slaughtered on the plantations to supply meat for the laborers or are sent to the cities for supplying the meat markets. Practically no animals or meat are exported, but certain beef and pork products are imported in large quantities.

General farming as we know it in the United States is not practiced in Cuba. Sweet potatoes, Indian corn, and the yucca are raised to supply a part of the food. Cuba could produce a great deal more of its food than it now produces; but Cubans do not take to this occupation, very few of the country people even having gardens.

The most accurate census of Cuba was that of 1899, at which time the percentage of total cultivated area devoted to sugar cane was 47.3, to sweet potatoes 11.3, to tobacco 9.3, to bananas 8.6, to Indian corn 7.3, to malangas 3.4, to yucca 3.2, and to coffee 1.6 (eight other minor crops are listed in the census).

When Cuba became independent, the percentage of land in farms and under cultivation was as shown in Table II.

TABLE II—PERCENTAGE OF LAND IN FARMS AND UNDER CULTIVATION IN CUBA IN 1899

| PROVINCE | PERCENTAGE IN FARMS | PERCENTAGE CULTIVATED |
|---|---|---|
| Havana | 45.6 | 5.8 |
| Matanzas | 41.4 | 6.6 |
| Pinar del Rio | 33.8 | 4.3 |
| Camaguey | 29.2 | .4 |
| Santa Clara | 30.6 | 4.0 |
| Oriente | 22.0 | 2.4 |
| Cuba | 29.9 | 3.0 |

It is reported that at the end of the Spanish régime Cuba had 91,000 plantations, farms, orchards, and cattle ranches valued at $200,000,000—an average of about $2,200 each. Table III shows the reported use of the land in 1850.

TABLE III—POPULATION AND CULTIVATION ACCORDING TO THE CENSUS OF 1850 BY DEPARTMENTS*

| | | WESTERN | CENTRAL | EASTERN |
|---|---|---|---|---|
| POPULATION | Total | 734,300 | 246,000 | 226,930 |
| | White | 325,500 | 153,000 | 87,060 |
| | Free colored | 88,300 | 42,500 | 74,770 |
| | Slaves | 320,500 | 50,500 | 65,100 |
| CULTIVATION | Sugar estates | 735 | 404 | 303 |
| | Coffee estates | 1,012 | 76 | 580 |
| | Tobacco estates | 3,990 | 967 | 4,145 |
| | Grazing estates | 1,741 | 4,881 | 3,308 |

* The Western department includes Pinar del Rio, Havana, Matanzas; the central, Santa Clara and Camaguey; the eastern, Oriente.

Notwithstanding the great quantity of sugar and tobacco produced in Cuba, not over one-tenth of the area is under cultivation, and several million acres of excellent sugar land have not yet been cleared. Little fertilizing is done.

## SUGAR[11]

Cuba's geographical position on the outer margin of the tropics gives it the ideal temperature and rainfall for growing sugar cane. While planters in Louisiana, with its winter frosts, must replant their cane each year, in Cuba cane does not require replanting for eight or ten, or even twelve years.

[11] Much of the statistical matter used in this section is taken from *Bulletin 53, Miscellaneous Series, U. S. Dept. of Commerce*, 1917.

It has already been pointed out that the major part of the soils of Cuba is derived from the breaking down of limestones and that there is a large proportion of level land; according to a recent *Commerce Report* "over three-quarters of Cuba is level enough to admit of the use of the most improved farm machinery." The red lands which are so conspicuous in Havana and Matanzas provinces and which appear elsewhere are a very porous residual clay loam through which water passes readily into the cavernous limestone below, giving excellent drainage and permitting tillage shortly after a rain. These red soils are by many regarded as the best sugar lands of Cuba. The black soils rest sometimes upon a white calcareous subsoil, and sometimes upon an impervious clay subsoil; they are exceedingly fertile, especially when newly cleared, and if drainage is good produce the heaviest crops of cane.

The ground is plowed, cross plowed, harrowed, trenched, and planted with pieces of cane containing one or more joints. During early growth the cane must be cultivated like corn. In from fifteen to eighteen months it is ready for cutting and may be cut annually for many years without replanting. An acre of good land annually yields twenty tons of sugar cane and two tons of sugar. As the cane matures, the lower leaves become dry and easily catch fire; in fact the greatest danger to the cane fields arises from fire, and special precautions must be taken against it.

The large crop of 1920–1921, reaching nearly 4,000,000 tons, was grown on about one-twentieth of the area of the island (1,400,000 acres). Thus five per cent of the land of one island yielded nearly a quarter of the sugar which the world used in 1921. This sugar was ground in about 200 mills.

In 1920–1921 the percentage by provinces of the total sugar crop produced was as follows: Santa Clara, 24; Oriente, 23; Camaguey, 20; Matanzas, 18; Havana, 11; Pinar del Rio, 2.

Each large sugar estate has its own mill, or central, from which railways or tramways radiate. At least one plantation has upwards of 200 miles of railroad and 25 locomotives, while another has 2,800 oxen, mules, and horses; and one group of 22 plantations has 15,000 work animals. The investment in a plantation and its mill reaches into the millions. A few of the largest mills produce 700,000 to 800,000 bags, or 200,000,000 pounds, of sugar a season. The cutting season is from December to about June, but it may extend even to September. The owner of the central produces only a minor part of the cane needed by his mill; the greater part—said to be 80 per cent—is grown under contract by tenant planters, called *colonos*, or is purchased from independent growers. There are about 22,000 *colonos* thus engaged in Cuba, the average area cultivated by each being about 66 acres. The cane is cut and stripped by hand, and this calls for a large force of laborers during the cutting season; but there is not sufficient employment for these laborers during the remainder of the year. Large numbers of Jamaicans and other West Indian negroes come for the sugar harvest, and many return home in the dull season. Some labor is recruited from

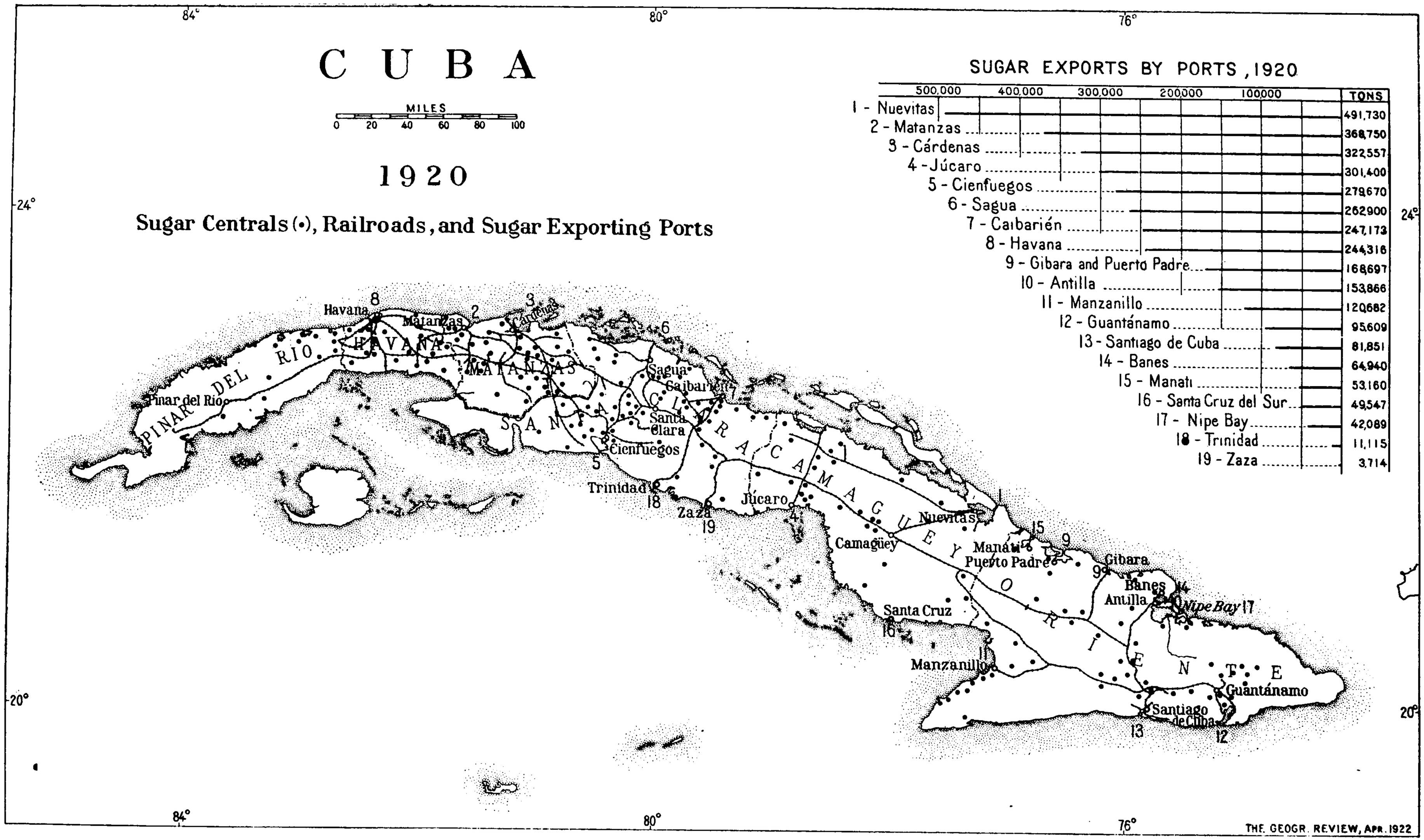


FIG. 5—Map of Cuba showing railroads, sugar-exporting ports and sugar centrals in 1920. The inset graph shows the amount of sugar export by ports. Scale approximately 1 : 6,600,000.

Spain and the Madeira Islands, but there is never enough. Shortage of labor is the chief problem that has to be faced by the planters. A majority of the 80,000 yearly immigrants into Cuba come for the sugar harvest. Much of the work is done as "piece work," the laborer being paid by the ton or by some other unit.

If Cuba could get labor or invent machinery to harvest the crop, the island could supply more sugar than all the world now produces. At average prices one good crop of cane is worth nearly the price of the land, and it is said that practically every central in Cuba made enough to pay for itself in 1918 and 1919; but in 1920–1921 little if any profit was made, and some of the largest companies lost heavily.

The cane is hauled to the railways and sometimes to the mills in ponderous ox carts over very bad roads, and the cost of getting the cane to the mill is one of the large items of expense. All parts of the island are so near the coast and there are so many harbors that no plantation is far from a shipping port. The increased production of recent years is mainly due to the many new American-owned estates which are being brought under cultivation in the eastern provinces of Camaguey and Oriente.

Cuba's geographical position is most advantageous for marketing the sugar, for it lies at the door of the greatest sugar-using nation in the world. The ocean freight rate on raw sugar from Cuban ports to New York, Boston, or Philadelphia, together with commission, brokerage, etc., normally is around a quarter of a cent a pound, an almost negligible figure. Moreover, the nearness of Cuba and its close relations with the United States have made it easy to attract American money, which has revolutionized the sugar industry by erecting the largest and most efficient of mills and by supplying ample funds for financing the industry. In 1916 the average cost of producing raw sugar in Cuba, including depreciation of plant, was less than 1.5 cent a pound, and a few mills made it at a cost of 1.1 cent a pound. With Spanish methods it cost three or four times as much, and present costs are twice as high as they were in 1916. About 40 per cent of the mills in 1916 were classed as American-owned, and at least $600,000,000 of American capital was invested. The number of American-owned mills has doubled since 1914, and they now grind more than half of the sugar. One company, the Cuba Cane Sugar Corporation, has over 20 estates, involving an investment of more than $50,000,000. An editorial note in *Facts About Sugar* of July 10, 1920, says: "The number of mills and plantations that have changed hands during the past six months represent values that run into the hundreds of millions of dollars. They exceed similar transactions of the past decade." In 1915 the sugar companies owned over 3,000,000 acres of land, less than half of which was under cultivation. Since that date many large purchases of land have been made, and it is probable that the holdings of the sugar companies now equal or exceed 4,000,000 acres.

Nearly all of the sugar is shipped from twenty ports, the majority of

which are on the northern shore of the island. The proportion shipped from any given port fluctuates from year to year but not very greatly.

## The Tobacco Industry

It was in Cuba in 1492 that Europeans first came in contact with tobacco, and it is in Cuba that the finest tobacco is still grown. The trade recognizes four general types of Cuban tobacco. The coarse, cheap grade grown in the province of Oriente is known as *Mayari y Gibara*. The *Remidios* of Santa Clara province and the *Portidos* of Havana are better in quality, but the tobacco that has made Cuba famous is the *Vuelta Abajo* of the province of Pinar del Rio in the western end of the island. Here in a very definitely marked area about 90 miles long and 10 miles wide, lying just south of the Organ Mountains, is grown the world's finest tobacco. It has been proved that the flavor and aroma of tobacco are determined more by soil than by climate. The texture and other physical qualities of the leaf are greatly improved by growing the plants under a covering of cheesecloth. The soil of the Vuelta Abajo district is a peculiar sandy loam, quite in contrast with the clay loams of the sugar-growing districts.[12] Why this particular soil should impart to the leaf the delicate and delightful quality possessed by no other tobacco in the world is an unexplainable but unchallenged fact.

The tobacco farms, called *vegas*, average from 30 to 40 acres in extent and are usually operated by Cuban owners with white labor—quite commonly Canary Islanders. Tobacco is a winter crop; the plants are set late in October in soil heavily fertilized and prepared with utmost care. In the Vuelta Abajo district one man devotes his whole time to about 2 acres, cultivating, pruning, and keeping off insect pests. This means that about 20 men are employed on the average farm of 40 acres. It has been estimated that 80,000 persons are employed in tobacco culture in Cuba.[13] Somewhat more than half of the tobacco grown in Cuba (in value) comes from the Vuelta Abajo district. Good tobacco land in this district is worth a thousand dollars an acre, or more, and often produces a thousand dollars' worth of tobacco per acre per year and in exceptional cases even two or three times as much. The leaves are cut in January, very carefully cured, and packed in bales of 50 kilos each. Havana is the center of cigar and cigarette making, a large part of which is in the hands of foreign corporations employing Cuban labor. The McKinley tariff placed a heavy tax on imported cigars, but a light tax on leaf tobacco; this caused many Cuban manufacturers to establish factories in Key West and Tampa where they continue to use skilled Cuban labor, both men and women.

During the fifteen years preceding the World War the exports of tobacco and its products averaged 22.6 per cent of the total exports from Cuba;

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[12] See the descriptions of the Vuelta Abajo district in J. B. Henderson: The Cruise of the Tomas Barrera, New York, 1916, p. 229 *et al.*

[13] R. P. Porter: Industrial Cuba, New York, 1899, p. 306.

but this percentage is declining, having been only 16 in 1914 and 6½ in 1920, while sugar rose to 91 per cent in 1920.

## Other Crops

Coffee, once highly important, especially in the eastern end of the island, has all but disappeared—unable to meet the competition of Brazil. The industry was established by refugees from Santo Domingo, some 30,000 of whom came into eastern Cuba about 1798. Cuba had 2,300 coffee plan-

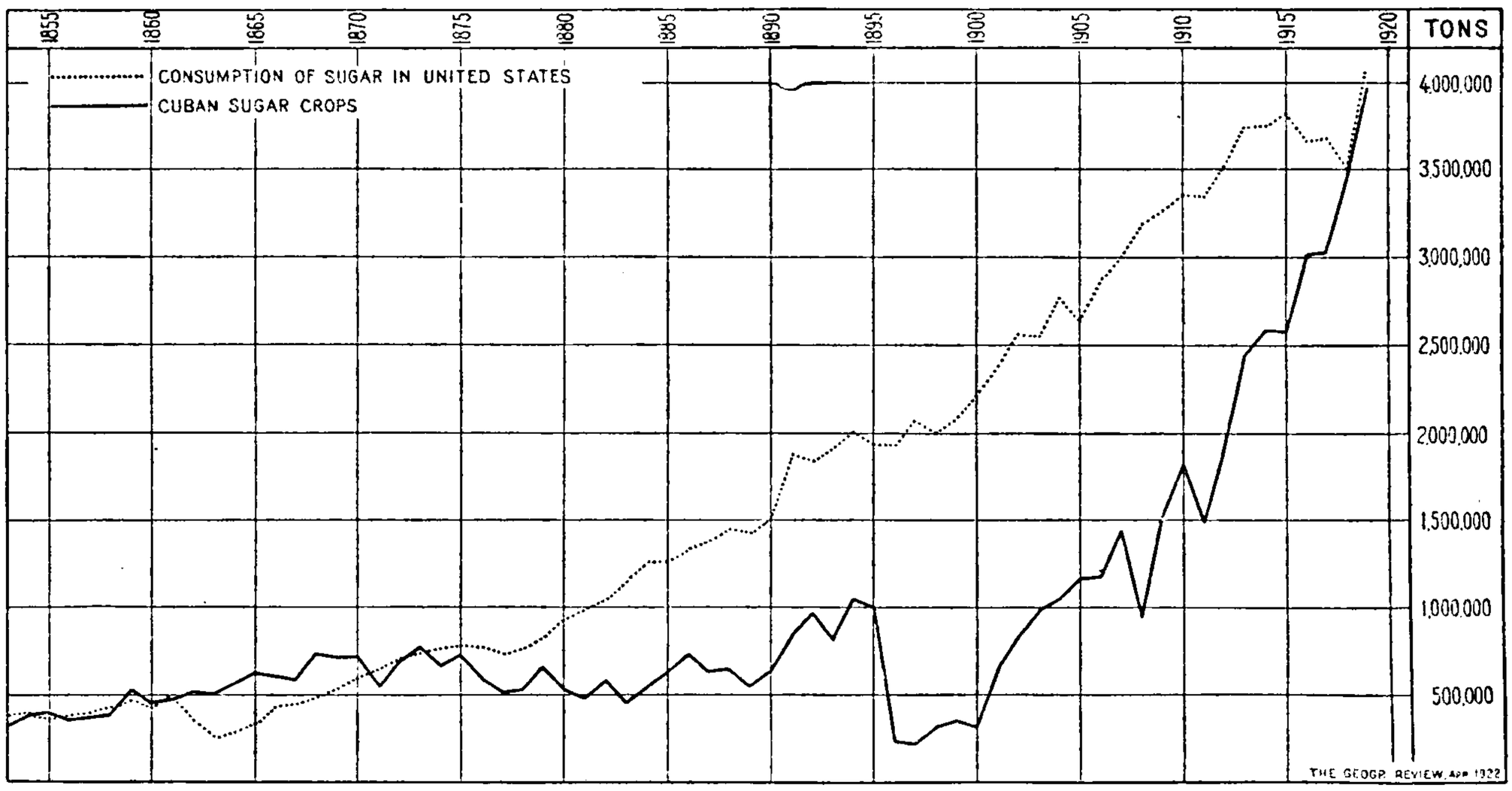


FIG. 6—Graph showing the importance of Cuban sugar production to the United States and the advantage to Cuba of a near-by market for her principal product. Note the effect of the rebellion of 1895 and the Spanish-American War.

tations large and small in 1846, at which time the permanent decline of this industry began in consequence of the violent hurricanes of 1843 and 1846. There was a partial revival after the independence of the island was achieved in 1898, but it was of short duration.

Henequen has been introduced from Yucatan and is doing well on land that was regarded as useless. Most of it is raised in the province of Matanzas and has given rise to two or three large mills.

Systematic fruit growing is relatively unimportant in Cuba, though a good deal of fruit is actually grown—much of it in a more or less haphazard way. The banana and the pineapple plantations attempted by Americans have been only partially successful financially. The fruit lands of the Isle of Pines, south of the western end of Cuba, are largely owned by Americans who have developed pineapple and grapefruit growing with moderate financial success. These fruits go by boat, daily trains, and car ferry to the United States. Over a million crates a year were shipped in the years around 1910, but the industry has since declined. Cuban oranges are delicious, but their production supplies only the home demand. It seems surprising that a tropical island like Cuba should import as much fruit as

it exports, but such is the case. Crawley[14] says that, of all the fruits that have been tried on a commercial scale, only oranges and grapefruit have given remunerative results.

## The Cuban Population

From the point of view of agricultural development the population of Cuba is not large. It is less than one-tenth of that of Java which has less agricultural land and still provides a surplus for export. According to the enumeration of 1909 (Statesman's Year-Book, 1921) Cuba has a total population of 2,898,905[15] of whom 1,020,411 dwelt in 11 cities.[16]

The permanent increase in population has averaged 65,000 a year during the twenty years of independence, while the excess of births over deaths averages from 40,000 to 45,000 annually, leaving a balance of some 20,000 a year to be accounted for by immigrants who stay in the country. Since the total immigration into Cuba is around 70,000 annually, it is evident that the great proportion of these do not remain permanently. This is, on the whole, a favorable arrangement for Cuba, although still more labor is needed between December and June of each year. Cuba seriously needs other industries which can absorb the unemployed labor of the dull season.

The Spanish explorers found Cuba inhabited by kindly Indians living peacefully under several independent chiefs. Their number was variously estimated at from 200,000 to 1,000,000. The latter figure is the estimate of Bishop Las Casas, one of the most careful students of Indian matters, yet it seems much too high. Under the enforced labor and cruelty of the Spaniards and the white man's diseases, the Indians rapidly disappeared and became practically extinct by 1550. As early as 1521 the importation of African slaves began and continued down to the middle of the nineteenth century. In all, a million blacks were imported.[17] Slavery was abolished in 1880, but many negroes had purchased or otherwise secured their freedom before that date. Much mixing of blood occurred, and it is probable that many of the people who are classed in the census returns as white have a strain of African blood in their veins. Spain did not draw the color line so closely as England or America, and it is not closely drawn in Cuba today. The census of 1877 gives Cuba 1,521,684 inhabitants and reports less than one-third of them as "colored" and over two-thirds as "white." An effort at close discrimination would be unwise and futile, yet the traveler in Cuba is quite skeptical of the latest census figures which class 75 per cent of the Cubans as white. There are unquestionably many pure-blood

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[14] J. T. Crawley: Progress of Agricultural Science in Cuba, *Proc. 2nd Pan Amer. Sci. Congr., Dec. 27, 1915, to Jan. 8, 1916*, Vol. 3, Section 3, Conservation, etc., Washington, D. C., pp. 374–382.

[15] By provinces: Pinar del Rio, 266,198 (51 per sq. m.); Havana, 697,583 (219 per sq. m.); Matanzas, 312,704 (95 per sq. m.); Santa Clara, 657,697 (70 per sq. m.); Camagüey, 735,810 (22 per sq. m.); Oriente, 735,810 (51 per sq. m.).

[16] The cities are: Havana, 360,517; Camagüey, 93,057; Cienfuegos, 83,092; Santiago de Cuba, 63,041; Manzanillo, 62,485; Guantánamo, 60,216; Sancti Spiritus, 58,843; Santa Clara, 57,767; Matanzas, 56,468; Pinar del Rio, 52,472; Cárdenas, 32,513.

[17] Census of Cuba, 1899. p. 68.

white Cubans, most of whom are of Spanish extraction. There are also several hundred thousand blacks; the latter are almost wholly engaged in the heavier forms of unskilled labor, especially the labor on the sugar plantations. Regarding the negro of Cuba, the census of 1899 (p. 69) says: "While the statistics of Cuba show a larger proportion of colored than white criminals, the colored population are in some respects superior to the colored population of our Southern States, being more self-reliant, temperate, frugal, and intelligent and, since the abolition of slavery (1880), showing a strong desire to own their own homes, to educate their children, and to improve their condition. In certain kinds of agriculture they are preferred to any other race. . . ."[18]

The country homes of the working people are primitive thatched huts of one or two rooms, usually with an opening for a door and with two or three windows. Often there is no floor and almost no furniture. The weather is never cold, and protection from rain is about all that is needed. One of the most striking contrasts between country life in the United States and in Cuba is in the homes and their surroundings. An attractive country home is seldom seen in Cuba except near the cities or around the sugar centrals. As a rule, little or nothing is done to beautify the surroundings of the homes in the villages and smaller towns. Such work requires effort, and the average Cuban in his tropical climate does not care to expend effort upon such things. Even vegetable gardens are seldom seen, for gardens, too, require effort, while plantain and banana trees do not.

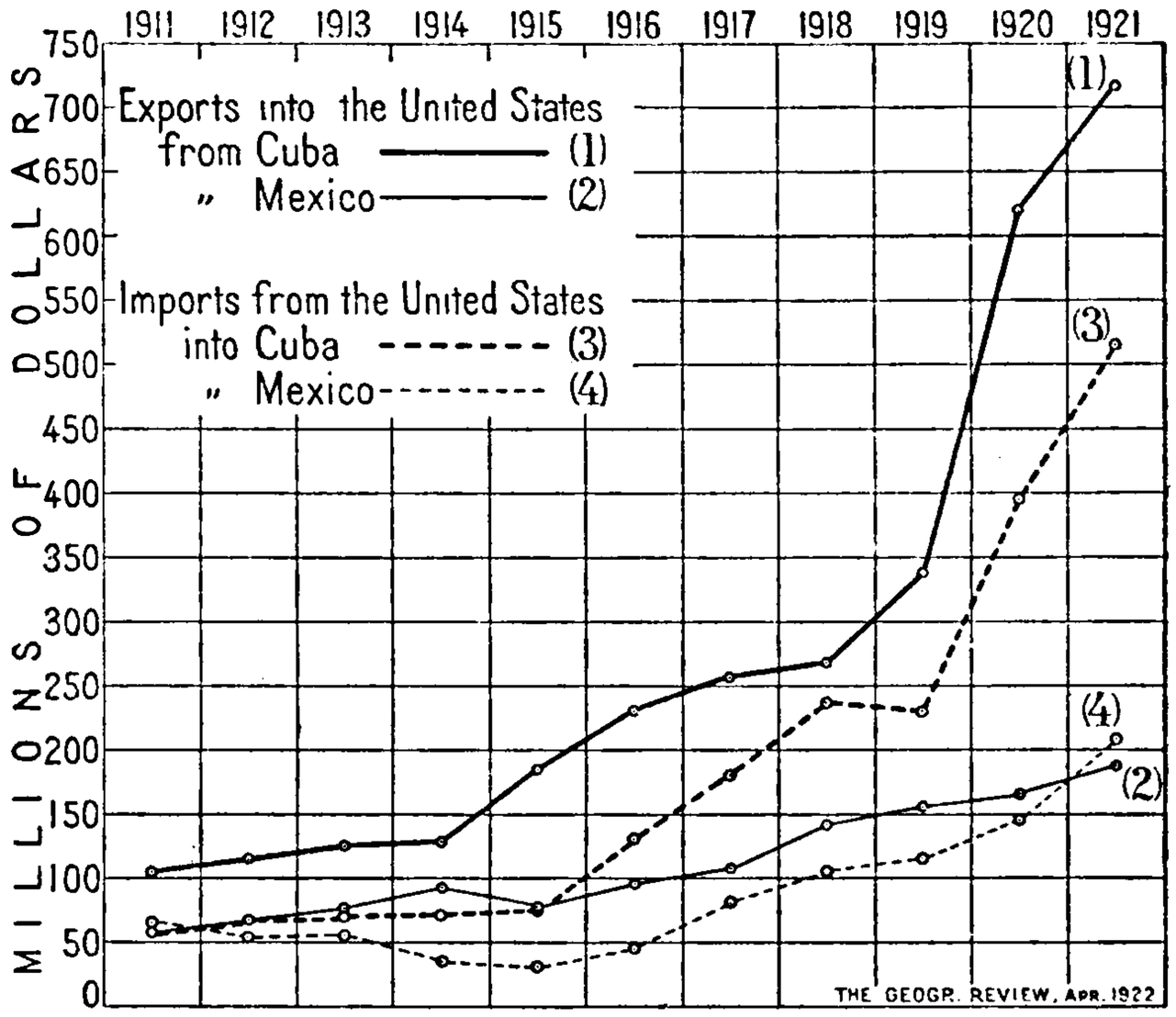


FIG. 7—Graph showing the recent growth of trade between Cuba and the United States. The effect of the close relations between the two countries appears the more striking when comparison is made with trade between Mexico (whose population is 5 times that of Cuba) and the United States.

## ROADS AND RAILWAYS

Most country roads, if indeed they may be called roads, are wretched, and in the rainy season well-nigh impassable for wheeled vehicles. During the American occupation excellent macadamized roads were built out from a few of the chief cities, and additional ones have been built by the Cuban government, making a total of 1,300 miles of first-class roads. The principal railways are good. Two Pullman trains leave Havana daily for Santiago, and two return, making the one-way trip of 550 miles in about

[18] See also R. T. Hill: Cuba, *Natl. Geogr. Mag.*, Vol. 9, 1898, pp. 193–242; especially pp. 224–233.

24 hours. The three western provinces are well supplied with railways, but Camaguey and Oriente have large areas without any. However, the constant extension of sugar estates in these provinces is resulting in a constant extension of railway lines. The main trunk line through the middle of the island is joined by lines reaching the many ports, and a great number of short lines connect the sugar centrals with the main lines or with the ports. In all, the island has some 2,800 miles of railway, or six miles for each 100 square miles of land area; this is about the same as in California or Colorado. In addition to the regular railway lines, there are some 4,000 miles of plantation railways belonging to the sugar estates and used wholly in their service. These roads have over 600 locomotives and nearly 20,000 cars for conveying cane. Despite this good showing, parts of Cuba suffer from the lack of transportation facilities. The wretched country roads add heavily to the expense of hauling all of the cane that moves over them. During the war, when manganese was in great demand, several of the mines of Cuba could respond but feebly because of the cost of about a dollar a ton-mile for transporting the ore five to ten miles by carts over unimproved roads.

## The Great Foreign Trade of Cuba

Aside from sugar and tobacco, the manufacturing industries of Cuba are small. There is, in consequence, a very heavy import trade in manufactured goods, 90 per cent of which comes from the United States. Cuba's population of less than 3,000,000 buys more American goods than China's 400,000,000; and in 1920 Cuba sold us products of greater value than any other country in the world. The benefit to Cuba of stable government and of close business relations with the United States comes out in a comparison of the trade of Mexico and that of Cuba with the United States between 1911 and 1920. As shown in Figure 7, the trade between Mexico and the United States increased but little while that of Cuba increased 600 per cent. The make-up of Cuba's export trade has averaged about as follows: sugar and its products, 75 per cent; tobacco and its products, 16 per cent; fruit, 2 per cent; minerals, 2 per cent; animals and animal products, 2 per cent; forest products, 1.5 per cent; miscellaneous, 1.5 per cent. The per capita value of exports from Cuba in 1920 was larger than that of any other nation in the world, and this is the same Cuba that in 1898 was facing starvation, and whose industries were all but ruined. Twenty-five years ago the climate was as good, the rainfall as copious, the soil as fertile, the geographical position the same as they are now; but Spain was in control. In 1898, because Cuba lay at our door, we intervened in her struggle for independence; we established and we now guarantee a stable government. Life and property were made safe with the result that new capital is willing to build million-dollar mills, extend railways, establish banks, and throw a car ferry from Key West to Havana. Cuba is capitalizing her fertile lands and advantageous geographical position.

# GEOGRAPHIC FACTORS IN THE RELATIONS OF THE UNITED STATES AND CUBA

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## Statement of the Problem

Nearly a hundred years ago President John Quincy Adams wrote:

. . . there are laws of political, as well as of physical gravitation; and if an apple, severed by the tempest from its native tree, cannot choose but fall to the ground, Cuba, forcibly disjoined from its own unnatural connexion with Spain, and incapable of self-support, can gravitate only towards the North American Union, which, by the same law of nature, cannot cast her off from its bosom.[1]

It has been contended that this principle has a universal application, and for it has been coined the term:[2] "politico-geographical law of gravity." In its general application it may be stated as follows: islands which lie near the borders of continents tend to become politically subordinate to the most powerful mainland neighbor. Cuba is an island of the utmost strategic and commercial importance, having for its nearest continental neighbor the United States, one of the larger, richer, and more powerful nations in the world. On the other hand, the two areas are widely at variance in history, nationality, language, social institutions, and political experience. While their geography has attracted, their social and political life has repelled. The concurrence of these conflicting forces therefore ought to give some proof of the validity of the "law."

## Environmental Factors Underlying the Problem

The location of Cuba and the United States has been of mutual importance. Cuba, lying at important crossroads of Caribbean and Gulf trade routes, commands the only two entrances to the Gulf of Mexico and one of the chief passages to the Caribbean Sea (Fig. 1). Thus it is in a position to bottle up the Gulf ports of the United States and to jeopard that nation's control of interoceanic canal routes. Furthermore, its many large and easily defensible harbors could serve as unexcelled bases for enemy ships engaged in blockading the ports or hampering the commerce of the United States. Conversely, for expeditions calculated to tamper with the political order of Cuba, the United States offers near-by shelter, particularly among the keys of Florida, which are separated from the populous sections of the continent by a waste of swamps. To commerce the proximity of island to continent is of basic import, for the short and cheap carriage

[1] Adams to Nelson, April 28, 1823, *32nd Congr., 1st Sess., House of Repr. Ex. Doc. No. 121*, p. 7.

[2] E. C. Semple: American History and Its Geographic Conditions, Boston and New York, 1903, p. 403. Cf. Friedrich Ratzel: Politische Geographie, Munich and Leipzig, 1897, pp. 386–391.

between Cuban ports and those of the southern and eastern coasts of North America has helped to make the United States Cuba's best customer and one of the countries from which it buys most heavily.

The climatic contrasts between the two domains, in conjunction with their proximity, have had further far-reaching results. Cuba, lying in the path of warm rainy trade winds, produces as its agricultural staples sugar and tobacco, besides cacao and tropical fruits and nuts.[3] These find a ready and constant market in the United States, which in turn can supply Cuba with cereals, meat products, and fabricated goods. Furthermore, the predominance of large-scale agriculture in Cuba opens an outlet near home for capital of American investors who wish to keep an eye on their projects. Finally, the fact that Cuban agriculture is chiefly of the plantation type resulted in the use of negro slaves, and the island was entangled for years in the perplexing slavery issue of the continent. More recently the mild Cuban winters have attracted pleasure seekers from the rigorous climate of northern United States, and Cubans in turn have spent their summers in the northern Appalachians.

FIG. 1—Sketch map to show the situation of Cuba in relation to the United States.

Even the mineral resources of the two areas are reciprocal. Cuba, deficient in mineral fuel, possesses a grade of iron which is necessary to the steel production of the United States; it also possesses copper. These commodities, finding their way to American ports, are replaced on the return voyage by coal and petroleum.

## Relations During the Spanish Period

Geographically bound together as the two territories are, it is little wonder that agitation for their political union began very early in the history

[3] See the preceding article, "Geographical Relations in the Development of Cuban Agriculture," by R. H. Whitbeck.

of the United States. In its incipiency this movement was general in statement and procrastinating in operation, but with the increase in the political and commercial power of the young republic and the diminution in the political and commercial significance of Spain, the clamor grew to overwhelming uproar. At first based on geographic hypotheses, the demand for Cuba came by 1840 to be rested on political exigency; after 1865 the cry was changed to commercial necessity and in the years following 1895 to humanitarianism. But these variations in argument meant no desertion of geographic principles, since neither the politics, the commerce, nor the humanitarianism would have appealed in force had Cuba been remote from the shores of the United States. Herein can be traced, nevertheless, the ever widening circles of interest in the island among the people of the mainland.[4]

In the earliest days of the independence of the United States Thomas Pownall, governor of Massachusetts, foresaw the ultimate incorporation of the West Indies into the new North American state: "Whether the West Indies are naturally parts of the North American continent is a question of curious speculation; the whole must in the course of events become parts of the great North American domain."[5]

## Definite Expression in Favor of Annexation

Definite pronouncements on Cuba, however, came only after the purchase of Louisiana and the consequent turning of the country's attention to expansion in other directions. It is not surprising that Jefferson, once committed to territorial extension, should put himself on record in favor of annexing Cuba, but it is a remarkable testimony to the state of his geographical outlook that he should have thought it could be defended without a navy. In 1809 he wrote:

> . . . I would immediately erect a column on the southernmost limit of Cuba and inscribe on it *ne plus ultra* as to us in that direction. . . . It will be objected to our receiving Cuba that no limit can be drawn to our future acquisitions. Cuba can be defended by us without a navy, and this develops a principle which ought to limit our views. Nothing should ever be accepted which requires a navy to defend it.[6]

The purchase of Florida by the United States in 1819 once again turned the public mind to further acquisitions in that direction, and after 1820 nearly every administrative leader of three decades is on record in reference to Cuba. The keynote to this period (1820–1848) was the fear of the United States that some strong European power, either France or Britain, would

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[4] The following classes of sources are the chief reservoirs of information: geographic theories and political platforms can be traced in the speeches and writings of public men; commercial interests found voice through the same channels, in periodical literature, and in government reports on commerce; humanitarianism was in part the cloak thrown about the subject by those who had interests of a more material sort, and its effects may be followed in public opinion during 1898.

[5] Quoted in A. B. Hart: The Foundations of American Foreign Policy, New York, 1901, p. 108.

[6] Jefferson to Madison, April 27, 1809; quoted in F. E. Chadwick: The Relations of the United States and Spain—Diplomacy, New York, 1909, p. 216.

seize the coveted island before it was ripe to drop into the lap of its neighbor. This corroborates the contention that the attraction of a more remote but stronger country may prove more potent than that of a country nearer but weaker.[7] That there was ground for this fear is shown by a cool statement of the London *Times:*

> . . . the certainty that the Floridas must belong to the United States, brings with it an invincible necessity for the acquisition of Cuba by the British crown. . . . The two transactions are necessary parts of the same whole, and must, if possible, be put out of hand together.[8]

By 1823 Jefferson had given up hope of annexing the island and aspired only to keep it from falling into British hands, by supporting its independence.[9]

J. Q. Adams was more hopeful of ultimate union, and in a far-sighted statement to the Spanish minister he set forth the reasons for the ambitions of his country:

> . . . [Cuba's] commanding position, with reference to the Gulf of Mexico and the West India seas; the character of its population; its situation midway between our southern coast and the island of St. Domingo; its safe and capacious harbor of the Havana, fronting a long line of our shores destitute of the same advantage; the nature of its productions and of its wants, furnishing the supplies and needing the returns of a commerce immensely profitable and mutually beneficial,—give it an importance in the sum of our national interests with which that of no other foreign territory can be compared. . . .[10]

So strong were his convictions that before the end of his term in office he sent as minister to Spain his confidential friend, A. H. Everett, who immediately began sounding the government as to its willingness to surrender the island to the United States as security for a loan of twenty million dollars without interest, payable at the pleasure of the Spanish government.[11] By thus adopting the methods of loan sharks Everett hoped to foreclose at some future date.

The bugbear of European aggression was momentarily submerged in a flood of fears lest Cuba become prematurely independent. In the heat of winning independence for Mexico and Colombia, Bolivar proposed to strike at the mother country through her only remaining loyal possessions in the New World, Cuba and Porto Rico (Fig. 1).[12] In a panic the Secretary of State, Henry Clay, undertook to beg the Russian government to induce Spain to give up her futile efforts to reconquer Mexico and Colombia.[13] Simultaneous overtures to the republics themselves resulted in relinquishment of their project, and the United States was freed from further apprehension in that quarter. The ever-present possibility of European action

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[7] Semple, *op. cit.*, p. 403.

[8] Quoted in *Niles' Weekly Register*, Vol. 17, January 8, 1820, p. 305.

[9] Jefferson to Monroe, October 24, 1823, in Writings, Monticello edit., 20 vols., Washington, D. C., 1904–05; reference in Vol. 15, p. 479.

[10] Adams to Nelson, April 28, 1823, *32nd Congr., 1st Sess., House of Repr. Ex. Doc. No. 121*, p. 6.

[11] Everett to Adams, cited in "Cuba Without War," *Scribner's Monthly*, Vol. 11, 1875–76, pp. 876–879.

[12] Number Four of the announced purposes of the Panama Congress of 1826, quoted in Chadwick, *op. cit.*, p. 210.

[13] Clay to Middleton, May 10, 1825, in "American State Papers, Class I, Foreign Relations," Vol. 5, 1858, pp. 846–849.

kept the State Department on the anxious seat as now and again British or French war vessels would make visits to Cuban waters. Spain was repeatedly warned that the United States would not tolerate the acquisition of Cuba by any other power,[14] and intimations of the same tenor were conveyed to the governments of Great Britain and France.[15]

## Complications of the Slave Question

A further political complication in American relations with Cuba made its appearance about 1825 and had thenceforth to be seriously reckoned with. This was the fact that slaves were held in Cuba with profit. To the slave-holding oligarchy in the Southern States this appealed in two aspects: first, they expected and dreaded emancipation of Cuban slaves in case the island were taken over by any of the countries which seemed likely to desire it; second, they feared that independence would lead to the installation of a negro state. In either case the example to slaves on the near-by continent would be dangerous to their masters. Clay hinted at the existence of this sentiment in his Russian letter.[16] As time went on it received more concise statement in the mouths of various leaders who were in sympathy with the dominant South. A letter from Webster to the American consul at Havana is typical:

> It is alleged that the British ministry and abolition societies . . . are . . . offering independence to the creoles, on condition that they will unite with the colored people in effecting a general emancipation of the slaves, and in converting the government into a *black military republic*, under British protection. . . . With 600,000 blacks in Cuba, and 800,000 in her West India islands, [Britain] will, it is said, strike a deathblow at the existence of slavery in the United States.[17]

This indicates clearly that while the fear of British control of the island was still present in the public mind, fear of British interference with the slave system had become far more potent; until 1860 it continued to be the dominant motive in the Cuban policy of the United States. After the Mexican War, when the slaveholders were flushed with victory and the mind of the whole country was favorably disposed toward further expansion, the administration was moved to put forth renewed efforts to annex the coveted island. President Polk and his cabinet determined to offer Spain a hundred million dollars,[18] but in the letter of authorization sent to the Spanish minister the urgent motive for desiring the cession was not mentioned, military expediency and commercial value being the assigned causes.[19]

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[14] Chadwick, *op. cit.*, p. 220. Van Buren to Van Ness, *32nd Congr., 1st Sess., House of Repr. Ex. Doc. No. 121*, p. 26.

[15] Stevenson to Forsyth, *ibid.*, p. 33.

[16] Work cited in footnote 13.

[17] Webster to Campbell, January 14, 1843, marked "Private and confidential," *32nd Congr. 1st Sess., House of Repr. Ex. Doc. No. 121*, p. 39.

[18] M. M. Quaife, edit.: The Diary of James K. Polk During His Presidency, 1845 to 1849, 4 Vols., Chicago, 1910; reference in Vol. 3, pp. 469–493, *passim*.

[19] Buchanan to Saunders, June 17, 1848, *32nd Congr., 1st Sess., House of Repr. Ex. Doc. No. 121*, pp. 42–49.

The rejection by Spain of this offer in no wise discouraged the Southern leaders, who, until the outbreak of the Civil War, never relaxed their efforts to possess themselves of the island. To a proposal by France and Great Britain of a tripartite guarantee of the existing régime in Cuba, they argued the special strategic and commercial interests of the United States as the excuse for prospective annexation:

> . . . it would seem impossible for any one who reflects upon the events glanced at in this note to mistake the law of American growth and progress, or think it can be ultimately arrested by a convention like that proposed. In the judgment of the President, it would be as easy to throw a dam from Cape Florida to Cuba, in the hope of stopping the flow of the gulf stream, as to attempt, by a compact like this, to fix the fortunes of Cuba "now and for hereafter." . . .[20]

## The Ostend Manifesto

The climax of this frenzy for annexation came with the Ostend Manifesto and its consequent agitation: in the autumn of 1854 the ministers of the United States to Great Britain, France, and Spain—two of them Southerners and the third completely in sympathy with the South—sent to the Secretary of State a letter advocating seizure of the island. It is notable for its extreme frankness:

> Indeed the Union can never enjoy repose, nor possess reliable security, as long as Cuba is not embraced within its boundaries. . . .
>
> After we shall have offered Spain a price for Cuba far beyond its present value, and this shall have been refused, . . . then, by every law, human and divine, we shall be justified in wresting it from Spain, if we possess the power; and this upon the very same principle that would justify an individual in tearing down the burning house of his neighbor if there were no other means of preventing the flames from destroying his own home.[21]

The publication of this rash statement was fervently received in the United States, and throughout the winter the war spirit was fanned by the newspapers, especially by the Washington (D. C.) *Union*, a sheet controlled by a close friend of Buchanan, one of the authors of the Manifesto.[22] Anticipating repudiation by the North, the administration refused to take the proposed steps without provocation by Spain, and the effort came to nothing.[23] Buchanan afterward sought to use his presidential office to gain the desired end, and the Southern periodicals did not cease discussing the Cuban situation from all angles.[24]

## Trade Relations and Cuban "Insurrectos"

An interest of increasing importance was the commercial development. Of Cuban exports of the day—sugar, copper ore, coffee, tobacco[25]—the

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[20] Edward Everett to the Comte de Sartiges, December 1, 1852, in "Correspondence on the Proposed Tripartite Convention Relative to Cuba," Boston, 1853, pp. 42–43.

[21] Buchanan, Mason, and Soulé to Marcy, October 5, 1854; quoted in Chadwick, *op. cit.*, pp. 263, 266.

[22] Sidney Webster: Mr. Marcy, the Cuban Question and the Ostend Manifesto, *Political Sci. Quart.*, Vol. 8, 1893, pp. 1–32; reference on pp. 26–27.

[23] Marcy to Shepard, April 15, 1855; quoted in J. B. Moore: The Question of Cuban Belligerency, *Forum*, Vol. 21, 1896, pp. 288–300; reference on p. 300.

[24] *De Bow's Review* and *Southern Quarterly Review*, *passim*.

[25] *Hunt's Merchants' Magazine*, Vol. 7, 1842, p. 330.

United States perennially consumed more than all other countries combined. Of imports the United States contributed a smaller share, chiefly because of the excessive tariffs levied by Spain on all goods of foreign origin; breadstuffs and manufactured goods were at the outset and consistently have remained the staples of the import trade.[26] A long succession of prosperous years in Cuba, unaffected even by the panic of 1837 and interrupted only by a revolt in 1828, came to an end in 1844 with a drought followed by a destructive hurricane.[27]

The succeeding depression worked hardship which naturally enough was laid to the door of the Spanish tariff laws. The discontent awakened a sympathetic response in the United States, and in 1849 Cuban *insurrectos* for the first time enlisted American citizens in their plans and used American ports as naval bases for filibustering expeditions. The first such venture was suppressed by United States authorities in New York, and the agitators consequently moved their headquarters to New Orleans, nearer the scene of operations and in the heart of the sympathetic Southland. Subsequent failure of co-operation in Cuba led to seizure of the conspirators by the Spanish authorities (in 1851), but their connection with the United States so exasperated these officials that American ships calling at ports of the island were subjected to numerous annoyances, culminating in the confiscation of the cargo of the *Black Warrior* in 1854. A tardy apology closed the incident, and the next few years saw an unprecedented expansion of trade between island and mainland. The financial crisis of 1857 and the Civil War played havoc with this business, but the Cuban trade recovered more quickly than did commerce between the United States and other countries. In 1864 it registered more than a tenth of the total, the highest percentage ever reached. In general, the Cuban question was quiescent during the Civil War, more nearly a dead issue than at any other period since 1800.

## Cuban Insurrections After the Civil War

In the United States the years which followed the Civil War were marked by the ascendancy of commercial and manufacturing interests. The republic had outgrown its childhood fears of British or French aggression; the continuance or abolition of slavery in Cuba was no longer an issue; but as a source of tropical products and as a market for the growing production of the United States the island took on a fresh importance. The keen-minded business men of the new United States grasped clearly the vital issue:

> The material development of Cuba . . . is chiefly due to its proximity to the United States. From the latter she has acquired the impulse to act, and the fever of enterprise. She has obtained at a small cost, on account of the nearness of the coasts, the numberless mechanical implements to reduce the laborers in the manufactories of sugar, and to convey it quickly to the coast. . . . Without that [United States] market of thirty millions of peo-

[26] *Ibid.*, Vol. 40, 1859, p. 280.

[27] D. P. Bailey: The Currency and Commerce of Cuba, *Banker's Magazine*, Vol. 35, 1880–81, pp. 697–704; reference on p. 699.

ple, Cuba's production would have remained wretchedly small. . . . Her well-being is not altered through Spain's disturbances, but by the pecuniary circumstances of Anglo-American merchants. . . .[28]

Contingencies affecting the commerce between the two countries were bound to react sharply upon their political relations. This is admirably illustrated by a comparison of the two insurrections which raged during the period. The first of these broke out in 1869 and continued intermittently for ten years; the second flamed forth in 1895 and was followed by the war between the United States and Spain in 1898. The two bear striking superficial likeness: both were fomented by Cubans resident in Cuba and abetted by Cubans resident in the United States; both began in the eastern end of the island and spread westward; both were carried on by guerrilla warfare and the destruction of property, especially sugar plantations; both involved a small number of Americans who insisted on lending aid to the *insurrectos;* both were marked by destruction of the lives and property of American citizens—acts which led to serious diplomatic crises. Why was one allowed to drag on for ten horrible years, whereas the other led to speedy intervention? Upon the answer hangs the solution of the problem under consideration, for if non-geographic factors are shown to be of major importance, the "politico-geographical law of gravity" must be declared unconstitutional, as least so far as this case is concerned.

A careful study of conditions between 1865 and 1896 shows that the similarity between the two insurrections was apparent rather than real, for in several essential particulars the fifteen years which elapsed between them altered the state of affairs. During the Ten Years War one of the shrewdest editors in the United States repeatedly declared that there was no sympathy with the Cubans except among "manufacturers of issues."[29] To be sure, the country was brought to a war pitch in 1873 by the capture of a vessel (the *Virginius*) flying the American flag and the summary execution of fifty of her passengers, but the excitement had so far died out three years later that the same editor could affirm that only the yellow press desired intervention and that there was less war spirit in the country than at any time within the previous fifty years.[30] Moreover, this was the very year in which President Grant made a gesture to end the contest by threatening intervention, on the ground that American property was being destroyed, that American commerce was being interfered with, that political exiles were taking refuge in the United States where they became disturbers of the peace, and that world-wide ideals of humanity were being violated.[31] The threat was not followed by action, apparently because the list of grievances stirred no response among the American people. The revolutionists held only a small part of the eastern end of the island, much of which

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[28] Spain and Cuba: The Geneva Pamphlet on the Relations Between Spain and Cuba, New York, 1876, p. 36.

[29] *The Nation*, Vol. 9, 1869, p. 24.

[30] *Ibid.*, Vol. 21, 1875, pp. 335–336.

[31] Fish to Cushing, "Paper No. 266," *44th Congr., 1st Sess., House of Repr. Ex. Doc. No. 90*, pp. 3–12.

was in a state of nature, and their depredations on the property of American citizens were confined to burning cane fields belonging to those who refused to pay blackmail. Even planters whose fields were ravaged suffered little, for cane is only slightly damaged if ground within a fortnight after burning.[32] Furthermore, in spite of some interference with commerce, there was no serious disturbance of trade, for the total foreign commerce increased during the insurrection,[33] and that with the United States reached in 1874 the highest figure, with one exception, ever attained during the Spanish ascendancy. Moreover, the drop in 1875 can as well be charged against the panic of 1873 as against the Cuban insurrection. This singular prosperity in war time and in the theater of operations can be explained in part by the facts that the revolutionists held not a single port, even in their eastern stronghold, and that the greater part of the wealth and population was in the western end of the island, the district never threatened by revolt.[34] While it is true that the disturbances drove many political refugees to the shelter of the neighboring States, especially planters of native birth whose sympathy with the insurrection had cost them their property, yet their propaganda was so ill-organized before 1890 that they cannot have been very troublesome to the American government. Finally, the sentiment of humanitarianism was not sufficiently developed to lend support to intervention.[35]

## Growth of Commercial and Social Relations

During the interval between the two revolts, however, all this was changed. The property holdings of Americans in the island increased amazingly; the confiscated lands of exiled "patriots" attracted the surplus capital of those who prospered under the post-bellum régime in the United States. President Cleveland estimated that in 1896 thirty to fifty million dollars of American money were invested in Cuban plantations, railroads, and mines.[36] Of this amount, some ten or fifteen million seem to have been in the form of advances by American merchants upon the sugar crop of 1896.[37] Commerce between the two countries displayed an equally astonishing increase. Immediately after the close of the Ten Years War there was a sharp slump, it is true, but this was in part a reflex of the poor state of the general foreign trade of the United States and in part a consequence of unsettled economic conditions in Cuba arising from the abolition of slavery and from increased taxation,—both concomitants of the war. After 1885

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[32] Murat Halstead: Our Cuban Neighbors and Their Struggle for Liberty, *Amer. Rev. of Reviews*, Vol. 13, 1896, pp. 419–438; reference on p. 420. See also *The Nation*, Vol. 22, 1876, p. 110.

[33] Memorandum of Fernando Calderon y Collantes to Secretary Fish, February 3, 1876; *54th Congr., 1st Sess., Senate Doc. No. 213*, pp. 50–54.

[34] *Ibid.*

[35] *The Nation*, Vol. 9, 1869, p. 24; Vol. 21, 1875, pp. 335–336.

[36] Annual Message of December 7, 1896; in J. D. Richardson: A Compilation of Messages and Papers of the Presidents, 1789–1897, 10 Vols., published by authority of Congress, 1898; reference in Vol. 9, p. 718.

[37] A. S. Hershey: The Recognition of Cuban Belligerency, *Annals Amer. Acad. of Polit. and Soc. Sci.*, Vol. 7, 1896, pp. 450–461; reference on p. 457, note.

trade increased by leaps until 1893, when it reached its maximum for the century. The great volume of commerce in this year was due to reciprocity between the United States and Spain, which became partially effective in July, 1891, and fully operative in July, 1892. By the terms of this arrangement sugar, cacao, coffee, hides, coal, petroleum, and machinery were allowed shipment free of duty, and the tariff on flour was reduced fifty per cent.[38] Since these were the principal items of trade between island and mainland,[39] the physical environment for the first time was given unrestricted play, and the results showed how harmful had been the self-seeking policy of Spain. The British consul general at Havana complained that "under the recent reciprocity treaty the United States of America practically supplies all the wants of the island and receives all its produce."[40] Since this trade was carried almost wholly in American bottoms, American shipping interests were benefited by the increase.[41]

Not only were the economic interests of the United States in Cuba broadened between 1879 and 1895, but less material bonds likewise were strengthened. On account of the proximity of the United States to their island, wealthy Cubans had for long sent their children here to be educated. After the failure of the revolt of 1869–1879 many of its leaders migrated to the continent. Numbers of them became citizens of the United States, and nearly all engaged in furthering the interests of the anti-Spanish group in Cuba. By 1892 it was said that most of the "patriots" were in New York and Florida, there being no organized revolutionary party in Cuba itself.[42] The inevitable consequence of the expanding economic and social intercourse between mainland and island was augmented interest on the part of the Americans in the affairs of Cuba.

## The Insurrection of 1895

Such, then, was the situation in February, 1895, when insurrection once more broke out in eastern Cuba It is generally agreed that the cause of the upflare was economic distress. The panic of 1893 marked the beginning, and the slump in foreign trade thus occasioned was intensified by the abrogation of reciprocity in 1894. At about the same time the beet sugar of central and western United States was becoming a formidable competitor of cane sugar. The sudden contraction of the market resulted in throwing out of work great numbers of Cuban plantation laborers, who formed the arm of the movement whose head was in New York—the so-called Junta. This clique had long been preparing for the eventuality now at hand: "trunkfuls of Cuban bonds," payable upon recognition of the

[38] "Reciprocity with Spain," *Quart. Register of Current History*, Vol. 1, 1891–92, pp. 218–220.

[39] The Foreign Commerce and Navigation of the United States, 1906, U. S. Dept. of Commerce and Labor, pp. 78–79.

[40] Quoted by E. S. Gould: Commercial Relations between Cuba and the United States, *Engineering Mag.*, Vol. 7, 1894, pp. 500–508; reference on p. 504.

[41] Thomas Jordan: Why we Need Cuba, *Forum*, Vol. 11, 1891, pp. 559–567; reference on pp. 562–563.

[42] Rollo Ogden: Spain, Cuba, and the United States, *Chautauquan*, Vol. 14, 1891–92, pp. 565–569; reference on p. 567.

Cuban Republic by Congress, had been distributed gratis among journalists and sold to Cuban sympathizers at three to ten cents on the dollar;[43] arms and ammunition had been collected; and filibustering expeditions had been arranged. When once the insurrection was under way, stores were smuggled out of United States ports, and isolated points along its fifty-five hundred miles of coast line south of New York (Fig. 1) were used as outfitting stations for seventy-one reported filibusters. These were aided greatly by the lonely keys of Florida. "It was the proximity of the United States and not merely Cuban energy, supported by the popular good-will of the country, which made the Union the principal source of Cuban supply. Exactly the same elements that made the close and extensive commercial relations in time of peace caused the active commerce in war material in the time of war.[44] . . ."

The difficulties confronting the United States government that arose from Cuban scheming were heightened by the acts of individual Americans. Several newspaper reporters in Cuba were harshly treated by the Spanish officials there; a Philadelphian importer of bananas, "finding his business destroyed by the outbreak of the revolution, promptly turned his ships into filibusters, and, after landing many cargoes of arms and ammunition, was eventually tried and convicted in a United States court;"[45] the action of other captains of American ships was from time to time so suspicious that the Cuban authorities were led to take unwarranted protective measures.

While relations with the United States were thus becoming strained, the utmost exertions of Spain were insufficient to cope with the insurrection. Tropical diseases decimated troops fresh from Europe, and the rugged and forested country enabled the natives to wage deadly guerrilla warfare.[46] As in the Ten Years War, the revolt originated in the east; but this time it spread rapidly westward until the glare of burning cane fields could be seen from Havana. The policy of the insurgents was to destroy all cane fields and sugar-refining machinery; the policy of the Spanish was to starve the revolt by cutting off importations of food and preventing agriculture except within the Spanish lines. Thus caught between two enemies, trade continued to dwindle, until in 1897 the United States was doing less business with Cuba than in any year for four decades. Even the American intervention, which, by severing formal commercial relations, in the next year reduced commerce to its lowest ebb since 1850, induced only a relatively slight diminution in the total volume of trade, and the exports of Cuban goods actually increased. Americans who had plantations on the island stood to lose not only the revenue from them but all movable property as well, and the advances on the sugar crop amounted to a dead loss. Natur-

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[43] *The Nation*, Vol. 66, 1898, p. 255.

[44] Chadwick, *op. cit.*, p. 419.

[45] R. T. Hill: Cuba and Porto Rico, New York, 1898, p. 81.

[46] T. Estrada Palma to Secretary Olney, December 7, 1895, *54th Congr., 1st Sess., Senate Document No. 166*, p. 13.

ally, injured Americans were bitter in their complaints; and the story of pecuniary loss frequently involved a tale of horrible outrage, such as generally accompanies guerrilla fighting. Public opinion in the United States demanded mitigation of the evils, and this temper was judiciously inflamed by politicians with ulterior motives[47] and by the yellow press.[48] The matter could not be kept out of Congress, which by resolution urged the President to take a stand (February–April, 1896).[49] The election platforms of both parties contained provisions committing their adherents to put an end to the Cuban disturbances, and, although the issue was buried under the avalanche of free silver, it remained—the index to an unavoidable predicament, viz.: the geographic proximity of Cuba. In his last annual message, President Cleveland felt compelled to devote considerable attention to Cuba.

> Were the Spanish armies able to meet their antagonists in the open or in pitched battle, prompt and decisive results might be looked for, and the immense superiority of the Spanish forces in numbers, discipline, and equipment could hardly fail to tell greatly to their advantage. But they are called upon to face a foe that shuns general engagements, that can choose and does choose its own ground, that from the nature of the country is visible or invisible at pleasure, and that fights only from ambuscade and when all the advantages of position and numbers are on its side. In a country where all that is indispensable to life in the way of food. clothing, and shelter is so easily obtainable, especially by those born and bred on the soil, it is obvious that there is hardly a limit to the time during which hostilities of this sort may be prolonged.[50]

## Intervention

The new administration turned at once to the task of settling the difficulty on a peaceful basis, but the President's efforts were nullified by the political parties, which were now racing to see which could gain the credit of snatching Cuba from the weakening grasp of Spain. The destruction of the United States battleship *Maine* in Havana harbor on February 15, 1898, heightened popular excitement and led directly to the crisis of April. On the eleventh of that month, McKinley sent a war message to Congress, carefully omitting mention of the future status of the island. The Republican House of Representatives responded dutifully; but in the Senate, where the interests of the Democratic West and South were stronger, a conflict occurred.[51] Besides the western and southern sugar-growers' fear of competition should Cuba become a part of the United States, there was in these sections a sincere desire to give the island its long-sought independence. The Democratic and Populist senators managed to have inserted in the resolutions calling for intervention, the following provisions:

> That the people of the Island of Cuba are, and of right ought to be, free and independent.
> That the United States hereby disclaims any disposition or intention to exercise sover-

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[47] *The Nation*, Vol. 61, 1895, pp. 250–251.

[48] H. S. Pritchett: Some Recollections of President McKinley and the Cuban Intervention, *North American Rev.*, Vol. 189, 1909, pp. 397–403.

[49] *Congressional Record*, Vol. 28, Part II, pp. 1317 *et seq.*

[50] Annual Message, December 7, 1896, *loc. cit.*, p. 717.

[51] *Outlook*, Vol. 58, 1898, April 23, pp. 995–996.

eignty, jurisdiction, or control over said island except for the pacification thereof, and asserts its determination, when that is accomplished, to leave the government and control of the Island to its people.[52]

Thus committed to a reversal of its century-old policy, the United States government entered the lists against Spain.

## The War with Spain

The geographic basis of the strategy of warfare is universally recognized. It therefore is unnecessary to discuss the operations of the War with Spain in detail.

Because of the insular character of the bone of contention, the issue was staked inevitably on a naval struggle. At the outset Spain had a slight preponderance of available naval strength, but this was more than offset by the necessity of fighting at arm's length across the Atlantic, a necessity which arose from the position of Cuba, close to the United States. Conversely, the American navy could operate from a base at home. The land operations were made possible by the fleet, and, while they aided in forcing an early conclusion of hostilities, the Spanish cause finally was lost in the naval battle of Santiago.[53] Within a month of the capitulation of Santiago preliminary terms of peace were signed, and Cuba was made over to the keeping of the United States.

### Cuba As a Dependency of the United States

As has been stated above, Congress, by a self-denying ordinance on the eve of the war, had disclaimed a desire to annex the island. Since this ordinance had been passed in response to the traditions and idealism of the American people, and in opposition to dominant economic interests, an important group in the country by no means considered Cuba's status settled thereby. Foiled in gaining complete control, this section of the public succeeded in passing through Congress as an amendment to an army appropriation bill certain provisions which Cuba was compelled to incorporate into her constitution before the American military occupation would be terminated. By these articles Cuba agreed to contract no debts beyond her interest-paying power nor otherwise to impair her independence; to permit the United States government "to intervene for the preservation of Cuban independence, the maintenance of a government adequate for the protection of life, property, and individual liberty . . ."; and to sell or lease lands necessary for coaling or naval stations of the United States.[54] These conditions having been complied with, the American troops were withdrawn in the spring of 1902. Thus the United States saved its face

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[52] *The Statutes at Large of the United States of America*, Vol. 30, 1899, Washington, D. C., pp. 738–739.

[53] The most useful Writings on operations of the war are A. T. Mahan: Lessons of the War with Spain, Boston, 1899, and F. E. Chadwick: The Relations of the United States and Spain—The Spanish-American War, 2 Vols., New York, 1911.

[54] The so-called Platt Amendment, passed March 2, 1901, *The Statutes at Large of the United States of America*, Vol. 31, 1901, Washington, D. C., pp. 897, 898.

before the world and at the same time safeguarded interests imposed on it by geography.

Proof that Cuba had not become independent but had only changed masters, appeared in 1906 when a revolution gave provocation for intervention in the destruction of property and excuse for it under the terms of the Platt Amendment. Troops were sent in to occupy the island, and there was widespread agitation among "planters, commercial men, and promoters" in the United States to have their government assume permanent administration of Cuban affairs.[55] The public felt, however, that the country was pledged to let Cuba work out its own destiny. Since stable native government satisfied most of the American interests there, the troops were withdrawn as soon as order was re-established.

A period of financial maladministration which threatened the economic prosperity of the island culminated in 1912 in election frauds and a second revolution. This time the American government dictated the selection of the chief executive under the guns of United States marines. There seems to have been less clamor for annexation than on the previous occasion. A third disturbance, likewise the outcome of a disputed presidential election, occurred in 1917. The United States again evidenced its intention to keep a firm rein upon its little neighbor, by giving the established government its moral support, backed by shipments of arms and ammunition and by the landing of marines at Santiago "to protect foreign interests."[56]

## Effect of the World War

The World War greatly stimulated sugar production in Cuba in three ways: it eliminated from the world market most of the beet sugar of Europe; it increased the demand, partly as substitution for alcoholic liquor, partly as an army staple, and partly for the manufacture of munitions; and it reduced shipping to a point which cut off the East Indies as a competitor in the Atlantic hemisphere. Under this stimulus foreign money, mostly American, was drawn into the business of increasing the Cuban output at a greatly accelerated rate. In 1919 there were 196 refineries in Cuba, of which 70 were owned by Cuban, 62 by American, and the remainder by other foreign capitalists. The Cuban mills were mostly small, and more than half the output came from American factories, which represented about half the total fixed investment in the business. Three-fourths of the total product was shipped to the United States.[57]

Under the influence of these conditions and of war prices fortunes were made by the score, and Havana became a resort of bonanza kings. For sound economic reasons Cuba followed the United States into war, and the

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[55] J. W. Foster: The Annexation of Cuba, *The Independent*, Vol. 61, 1906, pp. 965–968; reference on p. 966.

[56] "The Insurrection in Cuba," *Amer. Rev. of Reviews*, Vol. 55, 1917, p. 413. Cf. *The Independent*, Vol. 89, 1917, p. 344.

[57] W. J. Showalter: Cuba—The Sugar Mill of the Antilles, *Natl. Geogr. Mag.*, Vol. 38, 1920, pp. 1–33; W. W. Rasor: The Supremacy of the Sugar Industry in Cuba, *Pan-American Mag.*, Vol. 29, 1919, pp. 242–246. See also the preceding article, by R. H. Whitbeck, in this number of the *Review*.

fiscal machinery was geared to that of the continental republic. The Cuban National Bank, which had been established in 1905, was able to fix the standard of the Cuban dollar at the level maintained by the United States for its currency, and United States money, even to Federal Reserve bank notes, was made legal tender in Cuba.[58] Cuban sugar producers spent their summers in the Adirondacks, their fortunes in New York, and sent their children to eastern schools. A new interest in the English language sprang up throughout the island. It became evident that economic and social forms were shaping to the pattern of the physical environment. Political affairs could not hold aloof. Gradually party issues in Cuba came to center about future relations with the United States. The Conservative group supported the Platt Amendment, albeit urging that it be put in form of a treaty.[59]

## Progress Toward Stability

The Liberal group opposed further interference by the United States, but agreed with their rivals that economic stability must be insured.[60] As an outcome of this discussion the Judge Advocate General of the United States Army was called in to formulate an election law which should guard against the disturbances that had marred every election held under native authority, save one, and which had more than once resulted in intervention. On the basis of this law, which was approved in August, 1919, the election of 1920 was held. Unfortunately it occurred when the country was suffering the sharp pains of sugar deflation, and the usual disputes and threats of revolt followed. Once again the United States was forced to intervene, but this time a single arbiter was sent instead of a detachment of marines. His efforts to compromise the dispute were successful. Thanks to financial aid from the United States Federal Reserve Bank the economic crisis was safely passed, and Cuba once more regained fiscal and political equilibrium.

By these means Cuba has arrived at a stage of economic, social, and political co-operation with the United States which seems to assure her a prosperous future. Although technically independent, it can hardly be asserted that her sovereignty is not in the safe-keeping of the United States, which for a century has hoped and schemed for some such outcome. The extirpation of yellow fever, the establishment of schools, the development of public works, and, above all, the stabilizing of finances and the assurance of security to person and to property, are all the result of meddling on the part of the United States. Because of these constructive measures trade has flourished, and wealth has replaced poverty.[61]

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[58] W. H. Morales: Finance in Cuba, *Pan-American Mag.*, Vol. 27, 1918, pp. 147–148; George Marvin: Keeping Cuba Libre, *World's Work*, Vol. 34, 1917, pp. 553–567.

[59] "A Cuban View of the Platt Amendment," *Amer. Rev. of Reviews*, Vol. 56, 1917, pp. 539–540.

[60] "Cuban Criticism of the Platt Amendment," *ibid.*, Vol. 60, 1919, p. 95.

[61] M. G. Menocal: Leonard Wood As Administrator, *Forum*, Vol. 63, 1920, pp. 277–278; W. J. Showalter, *op. cit.*, p. 12.

## Solution of the Problem

In summarizing the foregoing discussion, it may be noted: first, that the United States always has desired to control Cuba; second, that during the years when it was too weak to seize the island outright, it effectually prevented any other power from filching it from Spain; third, that then followed a period when the tempting morsel would have been snapped up, had not internal division in America nullified all efforts to that end; fourth, that after unity was once more established, no conditions within Cuba stirred her neighbor to action until American economic interests in the island had experienced marked development; fifth, that these economic interests focussed attention upon the inhuman treatment being received by Cubans; and sixth, that when intervention had brought about control, that control was completely effective, in spite of limitations cast about it by the very humanitarianism which had been invoked to make intervention possible. Throughout these political ins and outs, the physical environment was playing its constant part. All the economic conditions were derived directly from it. The social interrelations, such as the rise of humanitarianism, are less obviously based on geography. And yet other nations as powerful and as civilized as the United States failed to be stirred to the point of intervention by Spanish barbarities, and the United States has at times withstood the temptation to intervene in behalf of equally abused but more remote peoples. The relations of Cuba and the United States prior to 1898 seem therefore to have been dictated, in all their larger aspects, by geography. The swiftness of the conclusion of the War with Spain seems clearly to have rested on environmental conditions, although the immensely greater force of the United States would hardly have failed to bear Spain down in time, under any circumstances. Since the war the geographic relation has urged the United States to set up and maintain a standard of government below which Cuba may not fall on penalty of subversion of her autonomy.

Finally, therefore, it may be concluded that, since Cuba was a strategically and economically important island, lying near a powerful continental neighbor but under the political control of a weak and remote country, and since geographic factors have been of basic importance in breaking those political ties and in bringing and maintaining Cuba under the suzerainty of the United States, the "politico-geographical law of gravity" stands in this instance as valid.

# PREHISTORIC GEOGRAPHY

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Fascinating as it is, the geography of the present is far less attractive than the geography of the past. In studying a modern region, for instance, we already know the facts—the areas of densest population and so forth—before we begin work. But before we can begin to generalize geographically about such a region as it was during some prehistoric period, the facts have first to be discovered, collected, classified, and mapped. It is not until this preliminary—and very laborious—research has been accomplished, that the archeologist is in a position to study the geographical aspect of his chosen period. Neither of these tasks can profitably be carried out by amateurs. Only long practice in the field can qualify for the delicate business of selection; and it is only by the informed imagination of the specialist that the distribution map can be adequately interpreted. This map is the goal of the whole undertaking, and its explanation in terms of geographical influence is one of the finest intellectual pleasures that exist.

## THE GEOGRAPHIC FACTOR IN THE DETERMINATION OF ANCIENT SETTLEMENTS AND TRADE CENTERS

The geographical features which emerge from such research are of two kinds. In the first place, and this is especially the case in dealing with prehistoric times, the facts whose distribution has been mapped fall into a number of distinct groups, which indicate the chief settlement areas of the period. In the second place the distribution indicates the existence of certain "nodal" points, many of which have now lost their nodality through a change in the nature of the control.

Let me take as an illustration the changes which have taken place in the distribution of population in England and Wales since the New Stone Age. We know from the distribution of Long Barrows that at the close of the Neolithic period, the uplands of the Cotswolds and the bare chalk downs of Wiltshire and Dorset were the most thickly inhabited regions of Southern England; and from the close association of these remains with springs and streams we can infer—what was obvious on a priori grounds—that within these regions the population clustered more thickly round those regions where water was easily accessible. Only by such a common sense hypothesis can we explain the existing distribution and, what is equally striking, the small bare patches (still within the group area) where Long Barrows are absent.

## Influence of the Geological Formation and the Water Supply

In the above instance two controlling factors can be discovered. The control of the groups as a whole is indirectly geological; primitive man selected those regions which were free from dense forest and marsh and which also provided good open pasture land to graze his flocks and herds upon. Graphically it may be expressed thus:

Geology ⟿ vegetation ⟿ domesticated animals ⟿ man.

Altitude may also exercise a controlling influence, as it does in the Welsh mountains. The second control is exercised *within* the group area by the universal need of water for man and beast.

A study of distributions during the succeeding period shows that in the main the same régime obtained. That was to be expected since the discovery of metal did not for a long time to come affect the fundamental needs which regulate social life. But the use of metal implements coincided with, and was no doubt partly the cause of, a great development of trade. The inhabitants of areas devoid of metal ores demanded, and were prosperous enough to pay for, such valuable tools; and their distribution reveals, outside the great settlement areas, little groups of finds at points of geographical importance. Among such are the harbors, especially those at the mouths of rivers whose valleys were a natural avenue of approach to the inland settlement areas. It is here that we see most clearly the different working of the geographical factor in past and present.

## Examples of Ancient British Ports

In the Bronze Age, if not before, the principal ports on the southern coast of England were at Bitterne on the eastern shore of the Itchen estuary in Hampshire, at Christchurch in the same county, and at Weymouth. Warrington, near the mouth of the Mersey, was also an important port. Of these four sites the first is still important, but the settlement is now concentrated at Southampton on the western shore of the Itchen; the second, Christchurch, has ceased to be a port; the third, Weymouth, occupies a spot probably to the north of the original settlement and is of far less *relative* importance than its prehistoric predecessor; and the fourth, at Warrington, has been superseded by the port at Liverpool farther down the river. Now of these four we may perhaps select Christchurch and Weymouth as the most important in prehistoric times, because they were the natural outlets of two of the largest and then most thickly inhabited regions —Salisbury Plain and Dorset. The people of these regions could obtain metal implements only by exchanging them for products of their own fertile districts; land communication being difficult and hazardous, we should naturally expect to find that sea routes predominated, and that the ports of call were those nearest to the region of the buyers. That is what the

evidence of distribution does in fact suggest in a way that amounts almost to proof. We may go so far as to say that the raw metal was exported, from Cornwall or Brittany or both, to Southampton and probably also Christchurch and was there smelted on the spot and cast into molds for axes. Positive evidence (still unpublished), consisting of the discovery of a crucible with bronze axes near Southampton, places this conclusion beyond doubt; and as a matter of fact the writer had arrived at it before this crucible was known to him, from the discovery in the same neighborhood of

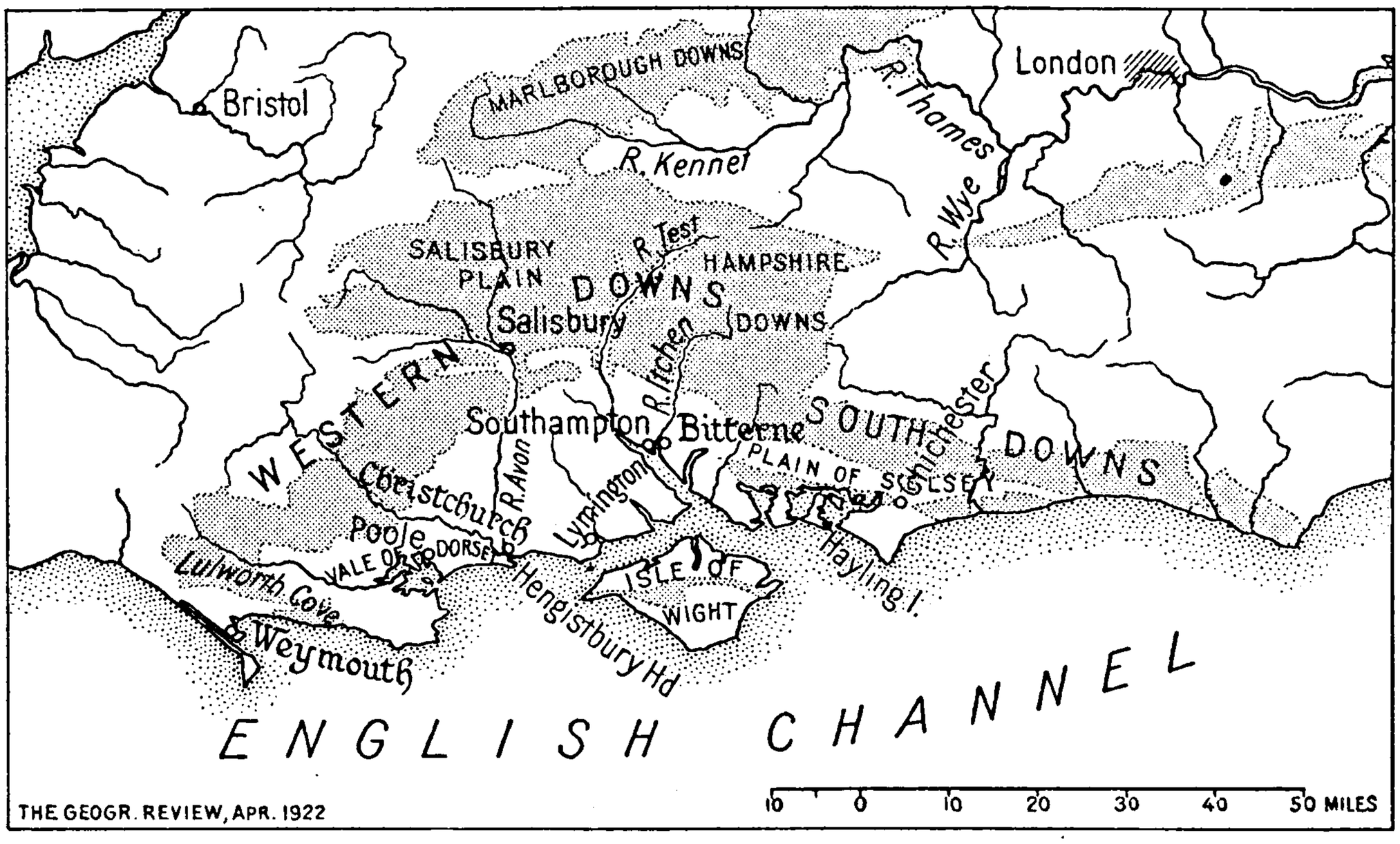


FIG. 1—Map of a part of southern England showing the site of three important ports of the Bronze Age (in antique lettering) in relation to the hinterland. The open chalk upland (shaded) was the seat of the densest population. Compare with the map of the habitable area of southern Britain in Neolithic time by H. J. Fleure, *Geographical Review*, Vol. 5, 1918, p. 219.

several "hoards" of bronze axes, newly cast and ready for transport to the inland marts. Closely allied to this discovery is that made at Hengistbury Head, within the area of a prehistoric camp, where remains of iron smelting were found. Their exact age is a little uncertain, and they belong of course to a later date than the bronze axes; but abundant relics of the Early Iron Age were found there, and we may safely assume that Hengistbury, which is less than a mile from Christchurch and at the mouth of the Salisbury Avon, was the port through which the people of Salisbury Plain obtained their iron implements before, and possibly during, the Roman occupation.

## PORTS AS DETERMINED BY "EFFECTIVE HINTERLAND"

What were the causes which made Christchurch and Warrington, for instance, so much more important in the past than they are now? The increase in the size of ships is not the only one which has operated. Had this been the sole factor we should find it difficult to explain the absence of finds round other "shallow-draught" harbors like Poole and Chichester.

The main factor which determined the selection of ports in prehistoric times was *the presence of a populous hinterland of effective buyers*. The port most accessible to that hinterland was bound to become the gateway through which imported goods entered it. Christchurch was the port of Salisbury Plain, and the broad gravel terrace of the lower Avon valley was its road of approach. Similarly Warrington was the port nearest to that island of population in the Peak District of Derbyshire and the one through which the copper of Ireland was probably obtained. It may also have derived importance from being an important halting place on a trade route between Ireland on the west and Scandinavia on the east.

In both these instances the determining factor is a reduction to a minimum of the land journey. It was this which caused Warrington and not Liverpool to be selected; if you could sail up as far as Warrington and thereby save several miles of land journey, you would certainly have done so in prehistoric times. A mile of sailing up an estuary was as nothing compared with the same distance on land, even if you did not actually carry the heavy ore on your own back (which you or your customers probably did).

Nowadays roads and railways have so altered land communication that a few miles makes no difference. But we may see the same principle—which may be called for short that of the *effective hinterland*—in operation just the same. Good natural harbors, like that of Kingsbridge in Devon, are of little commercial importance because they lead nowhere—neither to population nor natural wealth; but where these exist, as round Manchester, Leith, and Glasgow, artificial harbors have had to be made, or natural ones enlarged, by dock construction, canalization, and dredging.

## Causes for Shiftings of Relative Population Densities

But to hark back to the first point, why is it that the settlement areas—that is to say, the regions of densest population—of one period are different from those of another? It is because man, in his rôle of parasite, draws his sustenance now from one host now from another. The ultimate host is always the soil which produces vegetation which supports food-animals; but men may pay other men, in other lands, to supply them with these necessities. In prehistoric times the parasitism was direct; men lived on the country they dwelt in. Consequently the regions most thickly inhabited were those of great *natural* fertility, by which is meant regions immediately open to pasturage and agriculture without much initial expenditure of labor in clearing. The fertility of forest regions may ultimately prove greater, but it is at first potential only and needs much labor to develop. In prehistoric times, therefore, forest regions were relatively thinly populated. Nowadays, though we still live mainly on bread and meat and vegetables, we do not grow enough of these to support the whole of our population. We do not need to, because we can obtain these necessaries in exchange

for coal and all the variety of manufactured articles we produce through its energy. The world-wide demand both for coal itself and for those manufactures which are directly dependent upon it—in short, its general indispensability, unchallenged for a hundred years—has caused in that same short period a shifting of population almost without parallel in any country at any past period. Speaking very broadly, and excluding large towns, it may be said that few sudden changes took place in the distribution of population from the New Stone Age down to the beginning of the nineteenth century.

The most revolutionary change was made by the Anglo-Saxon invaders who deliberately chose to settle in the valleys instead of upon the high downs where the Romano-British and all their predecessors had had their encampments. But even they did not select their regions for any other reason than that of their potential food value; and the chalk regions, as usual, were the favorites. Such changes as took place from then onwards were of the nature of reclamation of wild land; but this process was gradual and did not amount to much in quantity, nor did it cause existing centers of gravity to shift appreciably.

It is a truism that the areas of densest population now coincide with coal fields; it will soon be recognized as a truism that in early prehistoric times they *generally* coincided with limestone areas—chalk, oolite, and carboniferous.

## The Geographic Factor in Archeological Method

I have emphasized the geographical influence and its shiftings because that is likely to be of most interest to geographers. To the archeologist, however, it is not so much the fact of the influence as the particular regions in which it expresses itself that matters. The whole subject is in its infancy, and there are many discoveries of the first importance to be made when archeologists realize the value of this method of study. I know of nothing so enthralling as to watch laboriously collected facts gradually sorting themselves out into homogeneous groups. The pleasure is the greater if, as often happens in prehistoric archeology, the individual facts themselves have not previously been recognized as akin. For instance, at the present moment I am engaged in compiling a descriptive list of the Chambered Long Barrows of Southern England. With the exception of two counties[1] no list of any kind existed, and it was necessary to start *ab initio*. In the course of field work many unrecognized and many entirely new examples were found, and the general kinship of all units forming this large group gradually became evident. In the light of experience it became possible to give an intelligible account of many isolated monuments of this class whose real nature had not previously been recognized. This marks the first stage, of collection and classification of instances. The second consists in plotting

[1] Gloucestershire, by G. B. Witts in 1883; and Wiltshire, by Mrs. Cunnington in 1914, the latter being by far the better of the two.

the sites on a map and examining their distribution. When this simple task of mapping is accomplished, one's first act is to superimpose a geological map and to see whether the formations where the sites cluster have any common traits. In the distribution of Long Barrows, as has been hinted above, the common trait is their occurrence upon some kind of limestone, especially near streams and springs. If, as may reasonably be concluded, the distribution of these tribal burial places is a clue to the past distribution of the living members of the tribes, we can proceed to form some tentative generalizations. We can proceed further than this; we can *foretell* that in other regions where similar conditions obtain, Long Barrows or other remains of these people will some day be brought to light; and this raises archeology very nearly to the level of an exact science.

I say "foretell;" the facts may be unknown to science, that is to say they may be unrecorded and known to a few persons only; or they may be entirely unknown. In either instance it amounts to prophecy in the scientific sense if their occurrence in the region in question is unknown to the foreteller. Let me give an instance. Before any excavations at all had been made or contemplated at Hengistbury Head I felt sure that the site was one of the first importance, for reasons which have already been given. Unfortunately I did not record my opinion on paper; but I came very near doing so when I said in 1912 that Christchurch was the port through which the gold of Ireland, so abundant in Wiltshire, must have passed.[2] And, as a matter of fact, the discovery in a round barrow at Hengistbury of a gold button case and other objects of a type common in Wiltshire but rare elsewhere, goes far to prove my contention.

It may reasonably be demanded that this claim to prophecy be justified here and now by concrete examples. I take up this imaginary challenge and give below the kinds of sites, with some specific instances of actual places where I anticipate that discoveries of prehistoric finds will be made or, if already made, will be found, when their distribution is mapped, to cluster most thickly. These prophecies are based on a few already known instances which appear to obey some law of universal application. In the present state of geographical archeological research such prophecy is still possible. That the subject is still in its archaic period is proved by the rarity and the primitive character of archeological maps.

1. *Drift implements of the Paleolithic period.* That these occur most frequently on the fork between the junction of two rivers has already been pointed out by Sir John Evans. They will also be found to occur, I believe, wherever the river which deposited the gravel in which they are found passes from the chalk into Tertiary country, and usually on the "chalk side" of the boundary.

2. *Neolithic implements.* Gravel islands in the marsh of a river valley and gravel promontories or banks by the side of a river (especially in Tertiary

[2] O. G. S. Crawford: The Distribution of Early Bronze Age Settlements in Britain, *Geogr. Journ.*, Vol. 40, 1912, pp. 184–203 and 304–317; reference on p. 196.

country) will be found very prolific in "flint fields." Generally speaking, the combination required is inaccessibility and ease of defence against man and wild animals, with a handy and abundant water supply.

3. *Bronze implements.* Wherever a navigable river or an estuary impinges *directly* upon the bare chalk, with no intervening strip of alluvial marsh, there I confidently expect a small dense cluster of find-spots on the map. Similar clusters are to be expected wherever the shores of such navigable rivers and estuaries are formed by gravel or other hard ground. Places of both kinds are abundant on both shores of the Thames estuary and occur also near the mouth of the Medway, the Cambridgeshire Ouse, and the Humber. Experience already shows that the majority of hoards occur near the seacoast; the probable reasons for this have been given above.

4. *Earthworks.* It is natural to suppose that people who lived within easy access of the sea or near the mouth of a navigable estuary would become the middlemen of trade between the interior and foreign ports. Their culture would contain a vigorous element of industrialism. They would be richer in objects made of imported materials than the agricultural and pastoral inhabitants of the hinterland. Their society would be urban rather than rural—I use the words in a half metaphorical sense only. Consequently those prehistoric camps and village sites which were thus favorably situated will better repay excavation than would those in remoter regions.[3] A site with geographical nodality will contain more remains; and it is probable on a priori grounds that amongst these may occur many exotic types introduced from abroad. Such types will prove invaluable both for purposes of chronology and for tracing the origin of a given culture. Another good reason for selecting coastal sites is that here we should expect to find the earliest settlements of an invading race, and consequently here will be found relics of the older culture associated with relics of the new incoming people. This again will be of great chronological value.

[3] If I were asked to give a few instances of places that would best repay excavation I should select (taking examples only from a region which I know) Bindon Hill above Lulworth Cove in Dorset; Buckland Rings and Ampress Hole near Lymington, Hants; Chilworth Ring and the camp on Toothill near Southampton; Tourner Bury Camp on Hayling Island; and perhaps one or two of the camps on the South Downs of Sussex.

# SOME ERRONEOUS IDEAS OF ARCTIC GEOGRAPHY

By VILHJALMUR STEFANSSON

## TRADITIONAL IDEAS OF THE POLAR REGIONS

"The Polar Regions" is in one sense a term in geography; in another sense it is even now a term in folklore, and once upon a time that aspect was far more important than it is today. We cannot study the origin of the ideas about the polar regions, for this doubtless lies in prehistoric times. Our earliest histories show us the ideas definite in form although almost wholly erroneous in content. It is probable that few people today have a clearer idea of the polar regions than did, for instance, the Romans and the Greeks. What those ideas were we shall not consider in detail, merely summing them up as a group of mental pictures of an area lying beyond the sheltering mountains of southern Europe filled with definite terrors more or less directly allied with cold and darkness. To people of subtropical lands the very idea of water in a solid state, as ice or snow, was gruesome. To those accustomed to a succession of days and nights that varied only slightly in length from season to season the thought of short days and long nights in winter was dreadful, and that of weeks or months without sunlight the depth of horror.

As civilization advanced northward the northern regions of darkness and desolation were gradually shifted farther and farther north. But the process was slow: the generally accepted idea lagged behind the acquisition of scientific facts. The "farthest north" of Pytheas was discredited by Strabo, who placed the boundary of the habitable world just north of Britain. And of the Roman conception of the possible northward extension of civilization we have a well-known presentation in the gloomy picture of Germany drawn by Tacitus. When the heritage of classical learning passed to the Arab scholars of the Middle Ages, they readily adopted the idea of the dark and frozen north. It was still the general belief of the Mediterranean peoples. In the thirteenth century we find Robertus Anglicus protesting in Montpellier against the geographers who ascribe to England "an uninhabitable climate."[1]

Even today parts of Norway that are in reality no colder at Christmas time than Wisconsin or Massachusetts, are likely to be pictured by our university graduates as the very outposts of desolation. This is not directly through a misunderstanding of the facts of geography and meteorology but is rather a survival, in spite of correctly apprehended scientific principles, of ancient inherited opinions about the terrors of the Frozen North.

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[1] Pierre Duhem: Le système du monde, 5 Vols., Paris, 1913–17; reference in Vol. 3, p. 292.

## Present-Day Misconceptions of the Arctic

Today the average intelligent person who is not a geographer or a meteorologist is likely to have the following ideas about the Arctic:

1. In general, it is dreadfully cold there at all times of the year; in particular, the minimum temperatures of winter are everywhere lower than they are anywhere in lands occupied by an agricultural population. In summer the greatest heat is not sufficient to make the days comfortably warm.

2. The Arctic lands are nearly everywhere devoid of vegetation. If there is any vegetation, it is mosses and lichens. A few people who are not geographers have heard that there are flowers in the polar regions, some even know that there are carpets of flowers; but this idea is prevented from becoming very enlightening by the assumption that these are all "lowly," "hardy," or "stunted" plants.

3. The Arctic is, generally speaking, devoid of animal life. In some places there are polar bears and seals, but neither of these animals nor any other is found in the water or on the ice when you get into "the remote polar regions" at great distances from land.

4. A certain mystical idea about the polar regions is responsible for a group of notions as follows: (*a*) that there is a peculiar deathlike stillness at most or all times; (*b*) that the polar night has a dreadfully depressing effect on the human spirit, but that (*c*) there is a certain fascination about the North which either in spite of its terrors or even because of them entices men of a peculiarly heroic mold into these dreadful regions, there to suffer and if need be to die in the cause of science.

We have perhaps not made this picture complete, but, so far as we have drawn it, it will be found substantially correct.

## Noises of the So-Called "Silent North"

A curious instance of how an inherited idea can fail to be corrected through repeated observation is found in "the eternal silence" of the North. It seems likely to me that had Sir Clements Markham lived to see the publication of his last book, it would not have appeared as it did under the title, "The Lands of Silence." Still, it is significant that a book under that title should have been published in 1921 after centuries of polar exploration and as a summary of what is known about the Far North and Far South.

We know from the fact that Sir Clements Markham had himself been in the North and also from his own writings that he was familiar with the great variety of summer animal life. A hundred species and more of birds nest largely or almost entirely north of the arctic circle. There are millions of cackling geese and squawking ducks and tens of thousands of cranes and swans and loons. Except for the noise made by our machinery rather than by ourselves, and except for possibly one or two beasts of the tropics, there is nothing in all creation more noisy than the loon; and no one who has ever

heard their ghoulish shrieks and their maniacal laughter can think of any place infested with them as being noiseless. But in the North we have, in addition to them and in addition to the birds mentioned, more than a hundred varieties of other birds, each making its own peculiar noise. And then there are the insects. The buzz of the mosquito cannot be said to be particularly loud, but it certainly is a noise that attracts the attention of anyone who happens to be about.

These are the noises of the summer, and there are also the whistle of the spermophile, the sharp bark of the fox, and the long howl of the wolf. In the winter the birds are gone with their noise except for the unobtrusive cackle of the ptarmigan and the occasional croak of a raven. Some owls also are there, but they are never noisy. The foxes bark occasionally, as they do in summer, and through the starlit night there resounds afar the howl of the wolf (wolves are found in most of the Arctic lands) either singly or in chorus. But even were they and all other animals absent, the winter would be by no means silent. If you are inland, about the only loud noises are the whistle of the wind and the resonant cracking of the ground when it splits and splits again under the influence of expansion and contraction with changing temperature. But few explorers have spent their winters inland; rather have they been on the coast lines or in some cases out at sea.

The book dealing with polar regions that was published in England immediately preceding Markham's "Lands of Silence" was Shackleton's "South," from which we quote:[2]

*July 25*. Very heavy pressure about the ship. During the early hours a large field on the port quarter came charging up, and on meeting our floe tossed up a ridge from ten to fifteen feet high. The blocks of ice as they broke off crumbled and piled over each other to the accompaniment of a thunderous roar. . . .

*August 4*. For nine days we have had southerly winds, and the last four we have experienced howling blizzards. I am sick of the sound of the infernal wind. Din! Din! Din! and darkness. . . .

Of similar import is a quotation from my own book, "The Friendly Arctic":

Two characteristic noises of southern lands are absent. There is not the rustle of leaves nor the roar of traffic. Nor is there the beating of waves upon a shore except in summer. But none of these sounds are heard upon the more southerly prairies. The treeless plains of Dakota when I was a boy were far more silent than ever the Arctic has been in my experience . . . near the sea at least there is, not always but on occasion, a continuous and to those in exposed situations a terrifying noise. When the ice is being piled against a polar coast there is a high-pitched screeching as one cake slides over the other, like the thousand-times magnified creaking of a rusty hinge. There is the crashing when cakes as big as a church wall, after being tilted on edge, finally pass beyond their equilibrium and topple down upon the ice; and when extensive floes, perhaps six or more feet in thickness, gradually bend under the resistless pressure of the pack until they buckle up and snap, there is a groaning as of supergiants in torment and a booming which at a distance of a mile or two sounds like a cannonade.[3]

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[2] Sir Ernest Shackleton: South, New York, 1920, p. 325.

[3] Vilhjalmur Stefansson: The Friendly Arctic: The Story of Five Years in Polar Regions, New York, 1921, p. 19.

## Summer Heat in the "Frigid" Zone

That the persistence of the idea that the Arctic regions are everywhere extremely cold at all times of year is not due to any misapprehension of geographic or meteorological laws, is shown by the fact that every textbook on geography lays down the principles from which we could deduce the fact that many parts of the polar regions cannot be as cold as certain other inhabited and "civilized" parts of the northern hemisphere and that the Arctic summer in certain places must be extremely hot. The weather bureaus of all northerly countries furnish facts to bear out these geographic principles. Yet most persons remain oblivious to them.

Psychologically there is another aspect to this case. The mind has a passion for simplicity. From the economic point of view there is still another angle. We are in need of every labor-saving device. To say that the tropics are always hot, the "temperate" regions neither hot nor cold, and the polar regions always cold, satisfies the mind's craving for simplicity and saves the time of the teacher, who gets an idea into the minds of his pupils with very little effort. The only trouble is that the idea is not correct—for any of the zones. The error of this simplified idea regarding the two former zones has been well put by Mark Jefferson, "What a suggestion of burning heat has the phrase 'torrid zone' and how unwarranted! And how pleasing is the name 'temperate' applied to our own zone! . . . so intemperate in fact that the only sound description of it that applies at all times is that every season is exceptional." [4]

The textbooks tell us that the amount of solar heat received at any point on the earth's surface depends on the angle at which the sun's rays fall and the length of day and, furthermore, that the rapid increase of length of day toward the pole during summer more than compensates for the decreased angle at which the sun's rays strike the earth. Hence at midsummer more heat per square mile is received within the polar regions than at the equator.[5]

This comes into flat conflict with all our inherited views as to the nature of the polar regions, although it explains satisfactorily such figures as those given by the United States Weather Bureau for the summer temperature of Fort Yukon, Alaska, four miles north of the arctic circle, where, according to the Bureau, a temperature of 100° F. in the shade was recorded in June, 1915. Nor are high temperatures unusual. Dr. Cleveland Abbe gives 90° as the summer maximum in the Yukon valley, and, while he questions certain extremely high temperatures (112° or over) that have been reported, he says "That it grows very hot in this province [Alaskan interior] no one may deny."[6] The average temperature of the warmest month at Fort

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[4] Mark Jefferson: The Real Temperatures Throughout North and South America, *Geogr. Rev.*, Vol. 6, 1918 pp. 240–267; reference on p. 240.

[5] This refers to values at the upper limit of the earth's atmosphere; but, even allowing for the loss of heat in transmission through the atmosphere, the ratio is high—according to Angot, 494 for the North Pole to 517 for the equator at the summer solstice.

[6] Cleveland Abbe, Jr.: Climate, in "The Geography and Geology of Alaska," by A. H. Brooks, *U. S. Geol. Survey Professional Paper No. 45*, 1906, pp. 133–200; reference on p. 155.

Macpherson, 65 miles within the arctic circle, is 58° F., only 1° less than that of San Francisco (59°). The mean maximum is 80°.

## Great Variety of Temperature Conditions in the Arctic

But it is not conservatism alone and the volume of inherited misinformation that have enabled the idea to prevail that the North is always cold. Different parts of the Arctic have very different temperatures. There are certain parts which never become very warm in summer, and, as it happens, some of the most widely known regions are included in them because they have been convenient to traders and travelers and have been, largely through what might be called accidental reasons, the base stations of many well-known polar expeditions.

Take, for instance, Greenland with its historical connections with Europe and its present-day interest as a Danish colony. The island is a mass of high mountains which store up "cold" in the form of the well-known ice cap and locally refrigerate the air so that there are only a few places in Greenland where it ever gets uncomfortably warm in summer.[7]

Another storehouse of cold is the polar ocean which saves up enough chill from the long months of winter to neutralize locally a good deal of the summer heat. North of the arctic circle it is only where you get far away from ice-covered mountains and far away from the ocean, in such places as the northern plains of North America or Asia, that you get the intense summer heat which no one expects who holds the historic view about the Arctic but which everyone expects who understands the principles of climatology.

## An Instance of the Retarding Influence of Tradition in the Development of Our Prairies

The lands that are the seat of our recent high civilization are mainly forest-covered except where the forests have been cleared away. Our people are accustomed to the idea that in order to be desirable a land must be forested. This erroneous view kept back the development of the frontiers of the United States, even as far south as Illinois, until the comparatively infertile lands around had been colonized. Only about half the history of the United States as a nation has passed since people came to realize that a land may be desirable though it be treeless. It was even more recently that our mid-western farmers saw that the absence of trees is an advantage, enabling them to cultivate at little expense lands more productive on the average than the fields reclaimed by decades of labor from originally forest-clad areas, such as those of Massachusetts or Wisconsin.

In going west from the Atlantic seaboard, the colonists did not expect to find undesirable land and were surprised and grieved when the prairie lay before them. Those who have gone north from either Europe or America,

[7] According to Hann Angmagsalik (65° 37′ N.) has a mean July temperature of 43° and an extreme temperature of 66°.

prepared to arrive at a region of desolation, found only the desolation they expected when the northern prairies lay before them, and wherever they went they filled their narratives with such adjectives as "barren" and "desolate." But, although they perhaps intended to indicate by those adjectives little beyond the mere absence of trees, they have conveyed a gloomier meaning to the stay-at-homes who read the books.

## Illustrations of Tradition in Current Descriptions of Alaska

An added reason why we find it so difficult to get correct ideas about the North is that even the writers who are trying to explain to us the friendliness and fruitfulness of the Arctic are handicapped in doing so by the molds in which their childhood thought has been cast. A good example of that is a recent article in the *Review of Reviews*. This is a magazine of the higher type. Furthermore, the author of the article evidently intends to be specifically truthful. The whole tenor of what he writes contradicts his opening sentence, which is as follows: "A new chapter in the story of the international search for oil is now being unfolded in the *frozen wilderness of the far North*."[8] By the words "the frozen wilderness of the far North," he obviously does not mean to convey the idea that the country is particularly frozen. To him this is merely a formula to describe the North and does not mean that the North is frozen any more than calling Michigan the "Wolverine State" implies that the most outstanding feature of that state is the omnipresence of wolverines. We see this clearly when we follow the article on towards its end, where we find the following: "The Imperial Oil drillers were furnished with vegetable seeds when they went north and requested to observe closely the results of their planting. They found that peas planted early in June were ripe on July 23. By the end of July potatoes were ready to eat and the grass was three feet high. The soil is a rich black loam. Some day this country may serve as a great agricultural district."[9] This, then, is the very district to which he refers as the "frozen wilderness of the far North."

Another good example is "A Cheechako in Alaska and Yukon," by Charlotte Cameron. Mrs. Cameron also intends to be truthful, and scattered throughout her book are rapturous exclamations over the marvelous flowers and fruits and vegetables which she found growing nearly everywhere she went in Alaska. I have checked up the route by which she traveled and have found that it must have been seldom that she came near enough to any of the high mountains of Alaska to see a snow-capped peak. She then means nothing beyond the use of what to her is a formula or a name for the North when she says in the "Afterthoughts" to her book:

> Was this journey of 20,000 miles really worth while? The hardships, the inconveniences, the rebuffs, were they worth it all?

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[8] J. W. SmallWood: Oil in the Frozen North, *Amer. Rev. of Reviews*, Vol. 63, 1921, pp. 639–644; reference on p. 639.

[9] *Ibid.*, p. 643.

> Of a surety! This long, long jaunt *to the Arctic snows* has brought me face to face with a race of men and women whom one is proud to own as kin—the pioneers, the men who blaze the trail, the men who, God willing, will point the way to that coming race of pioneers who will set out to conquer *these ice-locked vastnesses*.[10]

Of course, she or anyone can defend the description of Alaska as "ice-locked" by pointing out that there are some glaciers, especially near the southeastern corner of the territory, and that several mountains have snow caps. Still, no one will seriously maintain that the presence of glaciers around Sitka or Juneau is reason for calling Alaska a land of ice-locked vastnesses. The reason is historical. We are merely making fair acknowledgment by our vocabulary to the ancient southern civilizations from which our ideas have descended to us.

The experience of others confirms this. F. A. McDiarmid, describing the Yukon, finds it necessary to combat the old conceptions.[11] He says:

> For countless ages all peoples have looked upon the north as a wild and barren land, the home of the iceberg and the storm. In the past few years it has been given to a favored few to learn that the Yukon is a land of beauty, of sunny days and clear skies. . . .
>
> The enchanting beauty of the wide-spreading Yukon valley—its glorious sunshine and its wealth of vegetation and fruit and flowers—comes as a great surprise to one who beholds it for the first time; and often causes the exclamation "This cannot be the north." Indeed, it is not the north land of which we have read and thought perhaps to see.

## Other Factors Helping to Preserve the Tradition of the North

A set of reasons for the persistence of erroneous opinions about the North centers around the fact that many northern travelers have found it advantageous, for one reason or another, to perpetuate the idea of a land of desolation. Take, for instance, missionaries and explorers.

Many travelers are hostile in their attitude towards missionaries, saying that they do far more harm than good in such places as China and Turkey, the interior of Africa, and the northern coast of Canada. I am not one of these. My opinion is that it would be a good thing for the Eskimos if they could be protected from our "civilization" as a whole. But if our civilization goes to them, as it is bound to do, I would be the last to say that the missionaries should not go wherever the trader and whaler and prospector go. I think the missionaries help more than any other class of persons to temper to the shorn lamb the bitter wind of our civilization.

The missionaries are doing important work, or at least a work which they think is important. To carry on that work with full efficiency they must have a great deal of money. They have found out by experience, and the missionary organizations here have found out, that there is nothing that opens our purses so readily as the belief that these devoted people have been undergoing great hardships in the Far North for the glory of the Kingdom. Accordingly, it is only exceptional missionaries who take pains to

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[10] Charlotte Cameron: A Cheechako in Alaska and Yukon, London, 1920, p. 292.

[11] F. A. McDiarmid: Determination of the 141st Meridian, *The Journ. Royal Astronomical Soc. of Canada*, Vol. 2, 1908, pp. 84–95; reference on pp. 84 and 86.

explain what easy and pleasant times they have in their remote fields of work.

When lecturing recently in Indianapolis I was presented to the audience by a man who had written on certain aspects of Canadian and Arctic exploration. In his introduction he assured me that whatever I might say in my lecture about the pleasant aspects of polar regions and the ease with which one could live there, he for one would never believe me and my audience would not. That is the beauty of being a polar explorer. You can go far away and do things that are easy to do, come back and say the country is friendly and the work pleasant, and still get credit for being a hero who must necessarily have gone through terrifying adventures in a region of utter desolation! Furthermore, southerners do have real hardships in the North—real to them, at least—and when graphically related the hardships are admirably suited to keeping firm in our minds our inherited views of the dreaded polar regions.

## Stages in the Development of Arctic Exploration

We get a different idea, however, when we read the history of Arctic exploration during the last three hundred years and trace the gradual emancipation from its terrors. At first the travelers were in such dread of the northern winter that they made only summer forays in ships, returning home in the autumn. In the second stage of Arctic exploration they did pass the winter in the North, but practically in hibernation. It was a sort of trench warfare against the cold. They dug themselves in at the beginning of fall and managed to endure the tedium of winter through various devices, such as publishing a newspaper or the teaching of school where the officers were the masters and the sailors the pupils or various other occupations designed to kill time. In the spring they came out of their trenches in more or less trepidation and did what exploring was possible by their primitive methods during the spring and summer. As late as 1878 Sir George Nares declared that any polar explorer should be censured for cruelty who required his men to begin the work of exploration before April.

But long before the time of Nares, such pioneers as McClintock had begun to emancipate themselves from the imagined terrors of the Arctic winter. It was considered a great achievement, and was so in a certain sense, when they began to carry on sledge exploration under temperatures about the same as those at which children ordinarily go to school in winter in Manitoba and Dakota.

Explorer after explorer made advances, and one by one the imagined difficulties of the North were conquered until finally, in the time of Peary, only one or two obstacles remained serious. He had emancipated himself so completely from the fear of the winter that he laid it down as a principle that all important exploratory sledge work should be done in winter and that the journeys ought to be over before the snow began to thaw appreciably

in spring. He had devised a transportation system which we still consider the best for those parts. The two ideas that remained unconquered were that the polar sea is unnavigable (it really still is except that it is everywhere sailable by submarines) and that the polar ocean is devoid of food or fuel resources, making it necessary to carry large quantities of both. Peary himself, in his journey of four hundred miles from Cape Columbia to the North Pole, used about ten tons of food and fuel, all of which was exhausted before the journey was over.

The idea that the polar regions are devoid of animal life has been the most stubborn of the misconceptions and now remains the only one of our inherited views that is held by many explorers and many geographers. The pristine polar regions now survive only in the minds of the laity.

## Erroneous Beliefs Regarding Animal Life in the Arctic

When the pioneers came to the northern prairies, they were repelled by what was to them a great desolation. Sailors of southern seas were equally repelled by the ice-covered northern ocean. It was the theory of the landsman that whatever birds or animals might be in the North in summer would certainly move south in winter. Equally, the sailors believed that the whales and seals and fishes found on the margin of the ice would go south in the fall (which is really the case with the whale and the walrus) or would remain at the edge of the ice. It was thought that at no time of year would there be any considerable amount of animal life found in the sea beneath the fairly permanent ice covering of especially that part of the polar ocean which lies around the pole of inaccessibility—the center of the icy area, a point lying about four hundred miles from the North Pole a few degrees east of the meridian of Bering Strait.[12]

It is astounding how firm a hold these theories had on the early explorers. His whole record shows that Sir Edward Parry was about as truthful a man as ever lived. Honest as he was, he was unable to distinguish between theories which he held as unassailable and facts which he had actually observed, and so he tells us explicitly that the caribou and ovibos (musk oxen) of Melville Island leave that island in the fall and go south, returning to it in the spring.[13] We now know that neither the caribou nor the ovibos leave the island and go south. The ovibos stay in the island at all times, while the caribou do travel east and west at various times of year (not particularly in autumn), going from Melville west to Prince Patrick and east to Bathurst Island. There are some also that go north and south between Melville Island and the islands to the north of that. This may happen at any time of year when the ice is sufficiently stable. There is no

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[12] Vilhjalmur Stefansson: The Region of Maximum Inaccessibility in the Arctic, *Geogr. Rev.*, Vol. 10, 1920, pp. 167–172.

[13] "They arrived in Melville Island in the middle of May, crossing the ice from the southward, and quitted it on their return towards the end of September" (A Supplement to The Appendix of Captain Parry's Voyage for the Discovery of a North-West Passage, In The Years 1819–20, London, 1824, p. clxxxix).

southward migration from Borden Island to Melville Island in the fall nor any northward migration in the spring, but merely an erratic movement between. Furthermore, this fact has no bearing on Parry's statement, which was to the effect that the animals moved south from Melville Island and came north to it in the spring, a thing that has never been observed and has doubtless never occurred in the case of ovibos and seldom or never in the case of caribou.

When so reliable a man as Parry could make a definite but entirely unfounded statement about the absence of land animals from Melville Island in winter, it does not seem particularly strange that other equally honest explorers, confusing accepted theory with observed fact, make equally definite statements to the effect that animal life is absent from the ocean to the north of Siberia or Alaska or Greenland.

To begin with, explorers such as Wrangel or Nansen or Peary who traveled over the ice on the polar ocean had inherited from their ancestors the view that these were regions devoid of animal life. Quite as important is the fact that they came to the shores of the polar sea with the idea, which is held nearly universally, that primitive people, such as the Eskimos, are well-nigh infallible in their knowledge of the habits of the animals they hunt. They therefore took as fact what the Eskimos told them about seals being found only near land, assuming that these seal-hunting aborigines must know. Such an assumption should not be made. The Irish have been cultivating potatoes now for centuries, and still an Irish farmer will tell you things about the nature of the potato which you classify as simple superstition. Hundreds of generations of sailors have spent their lives on the sea and have discovered that the moon controls the weather, which it does not, and have failed to discover that the moon controls the tides, which it does. These things being so, need we suppose the Eskimos are infallible when they tell us about the habits of seals?

## Native Knowledge Not Infallible

As has been said, the explorers appear to have come to the North with the idea that in this field the Eskimos were infallible. The Eskimos told the explorers that seals are found only near land, and this was taken not as the expression of a view but as the statement of a fact. When, at latitude 86° N., Peary eventually saw a seal in an open lead,[14] this struck him and his Eskimo companions as remarkable (as he told me in conversation) and requiring special explanation.

The explorers, then, knew the absence of seals from the polar ocean far from land (*a*) through their inherited views, (*b*) through information from the Eskimos, (*c*) because they never saw them, and (*d*) because of the absence of polar bears which live on seals. It seems at first a reasonable assumption that if one animal's food is known to consist practically exclusively of another

[14] R. E. Peary: The North Pole, New York, 1910, p. 250.

animal, then you would inevitably find the predatory animal wherever the food animal is abundant. This logic has the flaw that a beast of prey may succeed remarkably well under one condition and fail entirely under another. A well-known example is the snowy owl which lives on mice. In summer the owls prosper everywhere in the polar regions because at that time the mice can be seen running around on top of the ground. In winter the mice are still in the northern lands just where they were in summer but they are in their frozen holes or going around, mole-fashion and invisible to the owls, under the snow. It seems clear that owls do not suffer from the cold of the northern winter and that the only thing which drives them south in the fall is the coming of the snow, a condition that protects the mice.

I am one of those who admire the cunning and prowess of the polar bear and believe that this animal has not as yet been given full credit by the animal psychologists for its comparative rank in intelligence. However, I do not consider it a piece of extreme vanity to suppose that I have more brains than a polar bear, that I might be able to get seals in a place where bears fail utterly, and might prosper by hunting in a place where no bear could live.

In this article I cannot go into the details of seal hunting as practiced by us out on that ocean which once was supposed to be devoid of seals. There is no novelty in the method we used. The only novelty is that we applied it in a region in which neither Eskimos nor explorers had considered applying it because of their inherited views to the effect that the seals were absent, and because they had inferred the absence of the seal from the absence of bears and bear tracks. With a party from my expedition I traveled for two years in a region where we never saw a polar bear track, and still while traveling we lived mainly on seals which we were able to get from under the ice, where they would have been safe from the utmost ingenuity of polar bears, even had the bears been there to look for them.[15]

## Conservatism Again a Hindrance to Discovery

The man in the street has ideas of the North that are his because the recent advances of science have not been able to change the current of popular thought as it applies to the north polar regions. The scientists themselves, being victims of their daily association with the average man and of the very vocabularies that have been built up under the influence of our old ideas about the North, have found it difficult to apply consistently to the deduction of correct views about the remote North their scientific principles evolved in southern latitudes. Had there never been a Mosaic cosmogony, with its six thousand years spanning all of human development, those might have been considered the most conservative geologists and anthropologists who made the longest estimates of the period that man as man has

[15] For methods of seal hunting, see Vilhjalmur Stefansson: The Friendly Arctic, pp. 171–172 and 301–310; *idem*, "Living Off the Country" as a Method of Arctic Exploration, *Geogr. Rev.*, Vol. 7, 1919, pp. 291–310.

existed upon the earth, for archeology shows that the bodily changes in man during the last seven thousand years have been slight, some say negligible. But it has been a fact in our day that those have been called conservative who have assumed or deduced the shortest possible period of man's history on the earth. They have esteemed it a sort of merit to make their conclusions conform to a cosmogony which, as scientists, they had entirely discarded.

There seems to be at present a similar tendency among authorities on the polar regions. Although the various sciences predispose us to make favorable conclusions about animal life in the North, we are still considered conservative in so far as we make our judgments conform, not to the principles of the sciences that apply, but to the views inherited from a superstitious ancestry. It has always been considered probable that great aggregations of animals might be found in the tropics or in the temperate zone. No serious doubts have, therefore, been cast upon estimates made in Africa or in the middle of North America about vast herds of grazing animals, whether eland or bison. I do not recall that I have ever heard questioned even the most extravagant estimates of the size of buffalo herds. These estimates, however, do not rest upon any other sort of evidence than that which goes to show that caribou move in the Arctic and sub-Arctic regions in herds equally large—say a million animals. But so strong in the public mind is the presumption for the barrenness of the North that the very men who have seen the herds which they think contain a million, will admit their real estimates to you only in conversation and will print instead of their real views statements more "conservative."

Similarly the oceanographers who have found out that animal life abounds at the margin of the ice make very guarded statements as to the probability of its extending under the ice. One by one we have already discarded nearly all of our former beliefs about the North. If in the case of any man we find nine statements of his to be lies, we incline to assume that the tenth is a lie also. In the case of the North, however, when we find our ideas one after another to be wrong, we still continue to act on the principle that the remaining ideas are probably true and that they must not be canceled except through overwhelming evidence.

## Animal Life Proved Abundant in Parts of the Polar Ocean

In my reasoning about the polar regions and in my work based on that reasoning I have treated the still-accepted views about the North as I would the still-undisproved statements of a man whom I have found uniformly unreliable. I have traveled in the particular regions which Sir Clements Markham selected to point out as devoid of animal life,[16] and there I found animal life particularly abundant. No one before our time has tried systematically to find animal life in the regions previously supposed to contain ittle or none, but we who have tried have so far succeeded everywhere.

[16] Sir Clements Markham: Life of Admiral Sir Leopold McClintock, London, 1909, p. 172.

Should we then be intimidated into "conservative" adherence to old beliefs and assume that we have happened upon one favorable region after another and that somewhere else in the polar ocean there must exist at least a little remnant of the desolate polar regions that were once so extensive? Or should we say that since the applicable sciences know no principle according to which the rest of the polar ocean should be any more "devoid of animal life" than the parts already shown to be abundantly supplied, the time has come at last to follow science and observation and to place the burden of proof upon anyone who desires to maintain that there is somewhere a large part of the polar area that conforms to ancient views?

As shown in my recent book "The Friendly Arctic"[17] and as previously brought out in my article "The Region of Maximum Inaccessibility in the Arctic," the area in the Arctic covered with so much ice that it has till now remained unnavigated is not symmetrical, with the North Pole for a center, as seems to have been commonly assumed by those who supposed that the geographic North Pole was one of the places devoid of animal life. The real center of the icy area lies in the direction towards Alaska, at about latitude 83° 50′ N., or 400 statute miles from the North Pole. If the iciness of the ocean is the reason why animal life is assumed to be absent, then the assumed area of desolation should lie roughly in a circle which has the "pole of inaccessibility" rather than the North Pole for a center. If we reckon from that center, we have already found seals so near the pole of inaccessibility that the North Pole is no farther from it. There is, therefore, the same presumption for finding seals at the North Pole that there is for finding them where we have actually found them.

## Arctic "Deserts" Not Large

As pointed out in the article to which we have just referred, we have found that certain areas of the polar ocean are better supplied with animal life than certain other areas. This merely corresponds to our knowledge of the continents and of the oceans. In any new land, in the sense in which North America was new four hundred years ago, the traveler who makes a long journey will find himself at one time in a region of more game and at another in a region of less. Similarly, the fishermen know that certain parts of the Atlantic are well supplied with cod and that in others the prospect of finding even one codfish is remote. From the point of view of animal life there are deserts on the continents and in the warmer oceans, so why should there not be similar deserts in the polar ocean? Thus far we have never found these seal-less areas very large. As we travel north we come into a district where there are less and less seals but, as we continue farther north, we come into another district where there are more and more seals. There appears, accordingly, no definite relation between the abundance of seals and latitude.

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[17] Pp. 8–11.

ot be considered proved that seal life is as abundant at the North
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er month on seals; but it appears to me we have carried our inves-
and reasoning on this subject so far that the burden of proof now
nyone who assumes that there is a part of the polar ocean, whether
h Pole or any other part, that is devoid of animal life or where
e is so scarce that a skillful hunter would find it difficult to secure
fuel for a small party of men and dogs.

# THE GEOGRAPHY OF HISTORY: A REVIEW*

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The World War of 1914–1918 and the Peace Conference which followed demonstrated with a clearness previously unknown that a knowledge of geographic facts and principles is fundamental to any adequate conception of the great problems of war and peace. The relative importance of the rôle which geography plays in history had long been debated, both in this country and abroad; and important works dealing with the "geographic basis" of history had been published in our own and other languages years before the cataclysm of 1914 burst upon the world. But it was the clash of whole nations in arms which revealed the true military value of efficiently mobilized scientific knowledge, including geographic knowledge; and it was the clash of national interests at Paris which exposed at the bottom of nearly every controversy a geographic foundation. That the lesson of these facts has not been lost to the world is obvious, for the man who speaks on problems of military geography or political geography enjoys a far wider and more attentive hearing today than he did eight years ago.

To no one dealing with the relations of geography to man and his activities, will a more respectful hearing be accorded than to Jean Brunhes, the distinguished author of "La géographie humaine" and professor at the Collège de France. When he speaks in collaboration with one best known for his writings on "Géographie sociale: La mer" and "Le sol et l'état," Camille Vallaux, his words must carry added conviction. The joint work of these two authors is in reality two volumes in one. The first is a general treatise on the relations between geography and history; the second is mainly a discussion of the World War and the problems arising from it, considered from the geographic point of view. It appears that the first was largely completed in substance, if not in its present form, before 1914; while much of the second is necessarily of later origin. It will not be inappropriate, therefore, if we confine our attention to the more general first part of this important work. The present writer will attempt the by-no-means easy task of translating into a few pages the chief argument of these two eminent geographers and will then append to this digest certain comments.

## Synopsis of the Work

If the distribution of towns and cities, of roads, railways, cables, and canals, and of all the other products of man's activities throughout the ages

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* Jean Brunhes and Camille Vallaux: La géographie de l'histoire: Géographie de la paix et de la guerre sur terre et sur mer. ii and 716 pp.; maps, diagrs., index. Félix Alcan, Paris, 1921. 10 x 6½ inches.

is geography, then certainly man in making history on the earth makes also geography. History, in other words, translates itself in geographic terms; and the great geographic facts of today are not the discoveries of the North Pole and the South Pole, but such events as the piercing of the Isthmus of Suez and the opening of the Panama Canal. On the other hand, geography translates itself in history. A high, flat-topped mesa, bordered by precipitous slopes and surrounded with a protecting belt of marshland, becomes the advanced bulwark of Christianity in the north of Gaul, an impregnable islet escaping the ravages of the Vandals, the refuge of the last Carolingians, a fortified city playing an important rôle in many wars. Can one doubt that the exceptional topography of Laon predestined it to figure as a stronghold from the earliest days of history? So also the unhindered exploitation of great natural lines of communication, like that of the Hudson-Mohawk depression, means rapid progress in the peaceful development of the adjoining regions; while the artificial blocking of such a route, as exemplified in Austria-Hungary's attempt to render Serbia commercially dependent on the Dual Monarchy by closing the natural pathway forming Serbia's direct outlet to the sea, can only end in one of those historical crises in which geography takes revenge against unnatural political doctrines.

## Man the Chief Geographic Agent

The interrelations of geography and history, barely touched upon in the preceding paragraphs but treated at some length by Brunhes and Vallaux, lead naturally to the discussion of men as geographic agents. In modifying the surface of the earth the sixteen hundred millions of human beings continually active upon it are far more important, in the opinion of our authors, than are the physical agents of nature such as volcanoes, glaciers, and rivers. This because of the vast scope of man's activities, his remarkable adaptability to varying physical conditions, and the infinite variety and incalculable number of his acts which in their totality profoundly and ceaselessly affect land areas; and especially because, as Woeikof has accurately remarked, man has power over the *movable things* on the earth. He can control the moving waters, dam them, change them into other forms of power, lead them in canals to serve as means of transport or to irrigate his fields. Agriculture depends on his control over the surface layers of the lands, his ability to break and move them, to remove some elements and add others. Road construction, house building, mining, manufacture involve the breaking in pieces and putting together again of the movable things on the earth. It is his power over these things which makes man of interest not only to the ethnographer, the historian, the statistician, but also to the geographer who sees in him the most important of all geographic agents.

Having established that geography and history are intimately related and that in considering their inter-relations we have to deal with man as the most important geographic agent, we turn naturally to the earliest human

records as the proper beginning of a study of "the geography of history." Here we have to note that the student of prehistoric records can no longer be satisfied with an attempt to discover successive stages of ancient civilizations superposed one above the other, and thus to establish a chronology of man's development in time; he must study the extension of these civilizations over the earth's surface, as affected by differences in climate, fauna, flora, and other environmental factors, at a time when man was far more dependent upon his physical surroundings than he is today. In the same way the earliest written history, those confused records of groups of men which constitute the dawn of history, can only be understood and rendered more precise when interpreted in the light of geography. The history of Greece and of Greek art is not fully intelligible unless one studies its beginnings with a true understanding of the peculiar physical environment formed by the island-studded eastern Mediterranean and its labyrinthine coasts, where the sea rather than the land formed the highway of human movements.

## Precautions Requisite in Geographic Interpretations

"Prehistory" and "protohistory" (early history) are succeeded by history proper, with its ever-increasing wealth of facts requiring analysis, classification, and interpretation. In this work the rôle of human geography is highly important. But the geographer must exercise care in making his interpretations, for, while many social facts have a geographic basis, it is equally true that many facts apparently geographic in origin depend upon wholly artificial social or psychological causes. Differences in the agriculture of two states may depend upon differences in the laws regulating the distribution of land rather than upon differences of soil, climate, or other physical factors. Care must also be taken that interpretations are not invalidated through failure to determine the statistical value of geographic facts. How many travelers judge a race by one accurately measured individual, or describe a people as hospitable after having been well received by the inhabitants of a single place! In geography it is not the exceptional fact but the usual fact, not the weight of an unusual stalk of wheat but the number of bushels produced per acre, not the rare specimen of mineral but the average run of the mine, that is of value. Finally, we must realize that what appear superficially as purely physical geographic facts, exercising a more or less fatalistic determination upon the acts of human beings, are often of significance only in relation to certain aspects of a changing human psychology. A river or a mountain is a "natural frontier" only when we have such and such economic and political conceptions of a frontier; and these conceptions change profoundly in the course of history. The "economic geography" of a given region may be greatly altered by the psychological fact of man's directing his attention to a new method of culture, as when the development of "dry farming" in parts of the western United States gave the same results as would a doubling of the local rainfall.

With the foregoing precautions in mind, the authors examine from the geographic point of view: (1) certain aspects of the distribution of agricultural products and man's progress in developing improved methods of agriculture; (2) the distribution of population over the earth and the causes of changes therein; and (3) the distribution and development of organized states (political geography). The object of this examination is to demonstrate that social history is solely determined neither by economic history nor by political history, but depends in an important measure upon geographic factors. Let us consider first the problem of population distribution.

## Unequal Distribution of Population

Men are very unequally distributed over the fact of the earth, sparsely scattered here, densely concentrated elsewhere. The mere matter of numbers is one of the sovereign laws of history; for the degree of concentration of men determines the force of resistance of certain great groups—as in China; the force of expansion of others—as in Europe. The world's population has increased by fifty per cent in the last century, a prodigious rate which is unknown in previous history and which has taken place largely in the European population or populations of European extraction; whereas the other two great centers of population—China and India—have remained stationary, and intertropical Africa has actually witnessed a decrease. Were geography, in its narrower conception, the determining factor in the distribution of men, we should expect the densest populations always to be found where nature offers the most abundant and most easily procured resources for food, shelter, and commerce. As a matter of fact, vast exposures of fertile lands with favorable climate remain little occupied, while at the same time many rocky lands with scanty, infertile soil and rude climate are peopled more densely than natural conditions warrant. Furthermore, where geographic conditions have remained sensibly unaltered, we not infrequently see today a scanty population where formerly great numbers lived. Evidently no geographic condition can in itself explain the extreme inequality in the distribution of men.

## Zones of Passive Concentration

If we examine the present zones of densely concentrated population we find them to be of two types: (1) zones of *passive* concentration, like China, India, Egypt, and the Sudan, "lands of water and sun," where the number of the population depends in great measure upon natural geographic conditions, and where these conditions favor not laziness, but limited and incomplete human effort; and (2) zones of *active* concentration, like parts of Europe and North America, where, natural conditions being on the whole unfavorable, the struggle for existence stimulates and invigorates men and favors their multiplication in order to provide additional means of over-

coming the difficulties which confront them. The relation of density of population to geographic conditions in a country of the first type is well illustrated by comparing three maps of India showing the rainfall, the culture of wheat, rice, and millet, and the distribution of population. These three maps correspond with an exactitude most remarkable. The term "passive concentration" is appropriate for countries like India and China, for in them the human plant thrives *in situ*, as in a favorable soil; and the population of these two countries, together accounting for almost half the people on the globe, has remained relatively stable throughout history, receiving little influx from outside and contributing little to the rest of the world. The limits of the population of India are almost as fixed as are the country's geographic limits—the Himalayas and the Indus. Nowhere have the Indians pushed outward, not even upon the ocean, which, although called Indian Ocean, has been successively Arab, Portuguese, Dutch, Franco-English, and now British, but never Indian. The expansion of the Chinese, while great when compared with the more stationary India, has been slight and slow as compared with the movements which peopled Europe and America.

## Zones of Active Concentration

In the zones of active concentration we find the population increasing as a sequel to man's struggle against the sea, against the forest, against the steppe. First it was the inland seas and the marginal areas of the greater oceans that witnessed the struggle. In so far as man drew his living from marine animals, the distribution of which depends in turn upon the temperature, depth, and movement of the sea water, he was subject to geographic limitations; and the early distribution of maritime populations in the northern hemisphere is believed to have resulted mainly from the thermal contrasts of warm and cold ocean currents and from the climatic and biological phenomena to which these contrasts give rise. But it was the struggle against the hardships of the fisherman's life that developed vigor in the population and increased its fecundity. Today it is the great ocean and maritime commerce, rather than marginal seas and fishing, that are responsible for the active concentration of population in the favored zones; for maritime commerce is a more powerful factor in drawing together in cities men from all parts of the world than ever were the great industries of "the age of coal."

The forest also invites an active concentration of population by virtue of the hardships it opposes to man, and both in Europe and North America great populations now live where once spread a wilderness of trees. In the struggle to clear the land not only are man's energies effectively developed, but an abundant offspring is necessary in order to provide more hands to conquer and cultivate the soil. Hence the forest zone of severe life conditions is peopled more rapidly than the steppe, where man is content to live in com-

parative ease a pastoral and more or less nomadic existence. Today, with the ancient forests largely conquered, population begins to increase more rapidly in the regions of steppes; but only because there is now more land available in these regions, and because the proper cultivation of the soil is there more recent.

## Influence of Water Supply and Coal Supply on Population

Another important factor in influencing the distribution of population is the water supply. This factor is not of consequence in the "lands of water and sun," where water, like the sunshine, is everywhere abundant. But elsewhere it determines whether the people shall be strung out along river courses, or concentrated in zones where common effort establishes a complex system of irrigation, or clustered more compactly about deep and therefore costly wells dug at the common expense, or scattered widely in little hamlets and isolated farms served by innumerable shallow and inexpensive wells. These conditions of living react upon the fecundity of the people, and hence still further upon the density of population.

The vast industries based upon the exploitation of coal in the last century have profoundly affected the distribution of men and in Europe have led to an active concentration of population in a zone adjacent to the belt of coal deposits extending along the fiftieth parallel from the Atlantic on the west to the great steppes of the east. But, contrary to the common explanation of economists, the concentration is not due simply to an influx of men from rural communities, attracted by the large salaries offered in the industries. The division between the rural population and the industrial laborers remains fairly distinct; the workmen are most often sons of workmen, for the laborers in no wise limit their offspring during the youth and maturity of industrial development. As a result the birth rate among laboring classes for a long time exceeds that of the rural population, as it formerly did in France and England, and still does in Germany. Further supplies of labor, above that furnished by the children of laborers, must for a long time be imported from a distance, for the rural population leaves the land for mine and factory very slowly and with many misgivings.

## Urban Concentration and Northward Migration

Two striking phenomena of the concentration of the white population of the world are, on the one hand, the ever growing tendency for men to leave the small and middle-sized towns for the great cities and, on the other, a gradual northward movement of the centers of maximum population. In prolific Germany, where the population has risen since 1871 from 40,000,000 to 68,000,000, the figure for the rural population has remained stationary at about 25,000,000. In France and England the cities continue to increase in size while the rural districts remain stationary or actually suffer a loss. In

the United States the relative proportions of rural and urban populations change yearly in favor of the urban population. Equally true, but so gradual as to be almost imperceptible unless we consider long periods of history, is the northward migration of urban populations coincident with the shifting of economic and political power in this direction. At an early epoch we find Thebes, Memphis, Babylon, and Nineveh situated between latitudes 25° and 36° N.; later Byzantium, Carthage, Rome, Athens, Cordova, and Toledo, from 33° to 42°; and now Paris, London, Vienna, Berlin, Petrograd, and Stockholm, from 48° to 60°.

## Movements Not Explained by Geographic Facts Alone

If we turn our attention from the "facts of fixation" of population, considered above, to the "facts of movement," we must first have care not to attempt to explain human movements simply on geographic grounds. A brief study convinces us that people do not, for example, move from places where the natural facilities for existence are insufficient, to places where such facilities are superior. On the contrary, one may observe dense populations continue the struggle for existence and constantly increase in numbers where neither the soil, commerce, nor the industries make true well-being possible; while other regions, marvelously endowed in natural resources and in the accumulated products of human toil, not only are sparsely populated but continue to lose numbers through an insufficient birth rate or emigration and most often through both causes at once. The true explanation for such phenomena often lies in the fields of economics or psychology rather than in that of geography. Desire to avoid that subdivision of the ancestral property which results from having many children, an exaggerated love of easy living and a dislike of heavy toil, feminine aversion to suffering and the desire to keep intact cash capital as well as land combine to lower the birth rate and thus cause depopulation of rich lands like those of Normandy. In other parts of France rich country regions are in time deserted because the lure of the city eventually draws to it some of the most active spirits, who become artists, politicians, statesmen; and the rest follow in their wake, content to perform the most menial tasks in the city rather than till the soil. Elsewhere it may be political disorders, poor distribution of lands, or social causes which incite masses of men to migrate. In still other cases the movement clearly has a geographic basis. The discovery of valuable mineral deposits, the exploitation of forests, famines due to failure of rains, overpopulation of sterile lands incapable of yielding an adequate food supply either draw people to the favored localities or expel them from the unfavored. But we hesitate to explain the invasions of the barbarians and the great migrations of Asiatic hordes from east to west, either, like Kropotkin, by the gradual desiccation of central Asia, or, like Huntington, by oscillations of wet and dry periods. The desiccation has not been sufficiently accentuated, nor have the climatic oscillations been sufficiently pronounced, to change

radically the conditions or manner of living in Asia; and so long as the manner of living may remain the same, there is no natural reason for an exodus *en masse*.

## Migration Routes

If geography fails to explain many major facts in the movements of men, it at least has a special interest when we come to study the routes of those movements. Migrating masses have a tendency to avoid obstacles and to seek the natural passages opened by nature. Yet even in this part of our study we must observe caution, and note that this law is strictly true only when men are poorly equipped to contend against nature and are spread over a region lacking proper transportation routes and adequate protection for the individual.

In earlier days the main obstacles to human movements were mountain masses, deserts, forests, marshes, and the open sea. But the routes followed by migrating peoples were not merely, nor principally, the routes best calculated to avoid these obstacles. They were also of necessity the routes along which they could best *eat;* for food for such numbers could not be carried with them. Chief among these routes were the grassy steppes, usually bordering the deserts, where there was water enough for man and grass for his herds, and where the trees were not numerous enough to hinder the movement of the mass. The great migrations of early history were thus migrations of pastoral peoples and temporary farmers, who lived in tents, led their flocks with them, and lightly tilled the soil for a single season before moving on. A second type of migration route was formed by the margins of the seas. Here boats and fish replaced the herds of the steppe, and the life of the trader and fisherman differed widely from that of the pastoral nomad. Phoenicians and Greeks, following the borders of the Mediterranean; Scandinavian and German traders, warriors, and pirates, skirting the shores of north European seas—give us examples of sea-border migration. Finally the rôle of great rivers as routes of early migration, while a subordinate one, deserves mention. Today conditions are so far changed that the open sea, once the most formidable of obstacles, is become the great route of movement for masses of men.

## Development of the State

Having considered mankind first in its work of stabilization and exploitation of the soil, and then in its movements from place to place, we must next turn our attention to the three fundamental problems of political geography: (1) the territorial expanse of the state, (2) lines of communication and the frontier of the state, and (3) the capital of the state.

Possession of a certain expanse of territory is a primary condition of the formation of a state. The political association is born of the necessity of collective security, and this necessity appears only when men, appropriat-

ing territory and exploiting it to meet their needs, feel that they have a common patrimony to defend. Absolute and complete nomadism prevents the formation of a state. Another primary condition is a certain minimum density of population. There must be, among the men composing the group, sufficient intercommunication for the need of common security to be felt and for the organization of that security to be possible; and this does not exist where men are too thinly scattered. There must also be, in close proximity, other groups that are enemies or rivals, or capable of becoming such, which are likewise able to form states; for only thus does the need of security against outside attack become apparent. The state *se pose en s'opposant*. Hence arises the importance of the geographic conception of "position." The Eskimos occupy permanently no territory, have not the requisite density of population, nor the contiguity of opposing groups that would enable them to form a state.

Even when the conditions requisite for the formation of a state exist, the development of the state does not always meet with the same degree of success. In some places one state after another is born, quickly rises to power, and then dies, new states always rising from their ashes. Elsewhere development of states is slow and incomplete, and the groups composing them apt to come under the influence of their more vigorous competitors. We may call these the *active* and the *passive* political regions, and a study of them in their historical development, in order to determine how far geographic conditions are responsible for their marked differences, gives highly interesting results. It shows us, for example, that no state or group of states can exist without an active struggle within the state or between states. Political societies may live in peace, in the ordinary sense of this word; but they cannot live in repose. This constant struggle changes, not merely from year to year but from day to day and even from hour to hour, the map of the world—not the map as we are able crudely to represent it but the real map which would show, if we could but draw it, the actual political and social life of human groups at any given moment of their ever-changing existence. The historical maps to which we are accustomed give an appearance of temporary stability followed by sudden and often great changes, which has little relation to the never-ceasing progressive changes taking place.

The changes just referred to involve, among other things, an obedience of most large political societies to a "law of increasing agglutination." Great states grow from small nuclei by successive incorporations of adjoining small states which have neither sufficient internal cohesive force nor sufficient expansive force to maintain their autonomy. But, while this is a general law, it is not, as Ratzel and other Germans would have us believe, a necessary and universal law. In the political geography of Ratzel one sees the fate of Belgium and Serbia fixed in advance and reads the full meaning of that author's statement that "Europe and Australia really have room enough for but one great power."

## Political Significance of Lines of Communication

The second fundamental problem of the state is to assure the cohesion of the parts which constitute it, and to establish upon its periphery a permanent defense against interference from without. Of these two objects the first is realized through *lines of communication*, the second by means of a *frontier*. Lines of communication are not commonly regarded in this light, so greatly has their secondary use for economic purposes obscured their primary purpose. This is natural, for in times of peace we see water routes, roads, railways, and telegraph lines serving the free movement of men, goods, and thoughts. Only in time of war does the primary purpose of these routes become evident, and only then do we realize that their most essential characteristic is *permanent security of passage*, obtained by removing material obstacles, maintaining a proper upkeep, and furnishing adequate police protection. Security of passage throughout its parts is essential to the cohesion of the state, and state supervision of lines of communication is one of the clearest proofs of political possession of the land. The great central artery of the Persian Empire which, significantly enough, coincided for long distances with the route of the Bagdad railway, and the network of roads which bound together the component parts of the Roman Empire are familiar illustrations in which the political significance of lines of communication is clearly apparent.

## Frontiers

In studying the frontiers of states we must first rid ourselves of the false notion that the frontier can be a line. Frontier zones are realities, the frontier line is only an abstraction. Every true frontier is a zone more or less completely organized for military and economic defense against the neighboring state. In this zone are concentrated the pressures and counterpressures inevitably resulting from the struggle for existence of two organized peoples. Those misguided individuals who hope to realize Utopian ideals by abolishing boundary lines between nations fail to understand that such lines are not created by statesmen to limit the freedom of peoples but represent attempts to define and locate an inescapable reality. If the line were abolished, together with its associated military posts and customhouses, the zone of pressure and counterpressure between the two peoples would remain unaffected and would soon compel the recreation of the things abolished. Where there is active tension in the frontier zone, the boundary line is apt to change with comparative frequency to meet the changing balance of forces. But if the tension is relieved, through the decadence of one of the states or its expansion in other directions, we may have a *dead frontier*, one with little tendency to change. Before the Treaty of the Pyrenees in 1659 the Franco-Spanish frontier suffered frequent changes in position; since that date and the fall of Spain from its place as a great power there has been no tension, and it has not even seemed worth while to correct the obvious blunders of the negotiators of that treaty.

The study of European frontiers shows their gradual transition from wide and little-inhabited zones between peoples, through a second stage in which the vacant zone remains on the side of the more barbarous people but is replaced by a protective wall or line of fortifications on the side of the more advanced state; then through a third stage in which there is no vacant zone but a chain of more or less detached fortified points, between which the two peoples interpenetrate each other most irregularly, with numerous enclaves of one group isolated within the other; finally reaching the fourth stage in which the more perfect internal organization of each state is reflected in a relatively simple and wholly continuous frontier between them. Such a study also convinces us that since neither rivers nor mountains serve as protective barriers to prevent the passage of armies, they do not constitute "natural frontiers." Practically there are, aside from the open sea, no natural frontiers between vigorous states.

## The State Capital

Just as there can be no state without lines of communication to bind its parts together and a frontier zone to protect it from outside interference, so also there is no state without a central organ, the capital. This is the third primary necessity for the existence of a state. The capital is the thinking head of the state; hence the disaster which threatens a nation if its capital is captured in time of war. State capitals are *natural* when they are established in pre-existing cities located where natural conditions favored their development; they are *artificial* when created where no urban development had previously taken place. When a pre-existing city is chosen as a capital, it is because in addition to its other natural advantages it possesses that of a favorable geographic *position*. Paris is the type example of natural capitals. Artificial capitals depend solely upon the advantages of position, and Petrograd, whose *site* is most unfavorable but whose *position* is admirable, was the best example. The government of Lenin has abandoned the artificial capital in favor of the natural capital of Russia (Moscow), and Petrograd is now in full process of decay. A study of the capitals of the world also shows us that about half of them are located on the sea or in close connection with the sea; and that for other reasons many capitals occupy a markedly eccentric position with respect to the territory of the nation and even with respect to the distribution of its population.

## Political Geography of the Future

If now we review the actual facts of political geography that we have thus far been considering and take into account those facts with which mankind will certainly have to deal in the near future, we can with some assurance predict certain aspects of the political geography of tomorrow. There is no essential geographic characteristic of the state which is not destined to

undergo profound alteration as a consequence of continued improvement in means of transport. The capitals, already overcrowded, will become more crowded still; recruiting their populations from afar, they will become ever more cosmopolitan and denationalized. Since acceleration of transport acts in effect as a reduction of distance, the size of states and the effects of size upon the cohesion of the component parts will progressively change. Such changes must in turn react upon the economic and social life of peoples.

One result of these changes will be to bring into existence in the future larger political organizations than the simple and homogeneous states which we know today. A common civilization, involving perhaps common traditions, a common mother tongue, a common religion, identical or analogous institutions, or only certain ones among these unifying forces, will lead different states to unite in a co-operative federation, either for the purpose of equalizing among themselves the conditions of existence or in order to resist successfully the growing pressure or violent attacks of other groups. The organization of these federated states will have little resemblance to the temporary alliances of the past. Such alliances have, until a very recent date, usually been concluded between two powers only. Under the growing pressure of new geographic facts an alliance between a group of powers has become more common. In the future the co-operation will be far more close, and individual relations between powers will be rare. The relations themselves will profoundly change and, instead of being directed, as in the past, largely toward securing an equilibrium of forces, will seek to achieve in addition an equilibrium in the distribution of raw materials and manufactured products destined to satisfy the needs of the peoples concerned. No nation will in the future be economically independent; and, since power rests on economic wealth, the states must gather into groups in order to combine those resources essential to great power. That these federations of states will be more permanent than the alliances of the past cannot be doubted, for they will be founded on geographic conditions far more stable than the military strength and moral elements which served as bases for the old alliances. Boundary lines will change less often, wars will become more difficult and dangerous and hence of rarer occurrence. But this gain to humanity may be more than offset by an increase in their devastating fury when they do occur.

## A League of Nations Impossible

It might seem that the logical end of the coming increased co-operation among nations would be a league of nations, composed of all civilized peoples and organized to make war impossible. Such reasoning is not justified. The essential aim of a league of nations, to make a final and lasting division of the earth's surface among the peoples of the world and to maintain thenceforward all frontiers inviolate, is impossible of achievement; because a perfect equilibrium, even if it could be once established, would

not endure. The great forces of political geography would destroy it. If the league of nations tried to take account of changing forces, it would find the task too delicate and difficult. The logical end, and the one best adapted to the realities of the present and of the future, is not a universal league of nations, but groups of federated states in unstable equilibrium accommodating themselves to changes in politico-geographical conditions.

## Comments

Thus far Brunhes and Vallaux. This digest of their argument is necessarily incomplete and imperfect, but it may be sufficient to indicate the wide range and compelling interest of their work. It remains to comment on certain phases of their treatment. The reader will appreciate the few maps and diagrams that illustrate the text. Nothing could be more effective than the series of diagrams (Figs. 2–5) showing graphically how improved means of transport have in effect caused France to shrink to a tiny fraction of its former size, changed Corsica to half its size and brought it within one-third its former distance from Marseilles, narrowed Dover Strait by two-thirds, and reduced the breadth of the Atlantic Ocean by more than three-fourths, bringing New York and Le Havre within 162 hours of each other instead of 734 hours as formerly. One could wish that the text were illuminated by more illustrations, for its value would thereby certainly be increased.

Two characteristics of the text leave a strong impression upon the reader. One is a certain lack of clearness, due possibly to the very wealth of material presented. To put a geographic statement in its proper setting requires, perhaps, a brief sentence touching on some related, though distinct, theme. But this sentence raises in the authors' fertile minds additional corollaries or examples, and the sentence becomes a paragraph or several paragraphs. The reader is interested but he is also diverted; and the logic of the argument is sometimes obscured. The second impression is that produced by the authors' commendable care not to overvalue or overemphasize the rôle of geography in history. The reader is repeatedly cautioned against the danger of attempting a simple geographic explanation for historical events, and emphasis is placed on the fact that much harm has resulted when over-enthusiastic geographers have sought to explain events from the geographic viewpoint alone, or to assign to geography too great a rôle in history or a rôle too simple and determinative. "The earth certainly controls human activity; but man in turn controls the earth."

It would not be fair to expect that in the subject matter of a work covering so wide a range of human interests as does "La géographie de l'histoire," the authors should escape grounds for criticism. In places the careful reader will follow the authors with doubt and misgivings, or feel that he cannot follow them at all. He may, for example, question the geographic quality of cathedrals, even though they are situated on the earth's surface, and can

be represented on maps. Similarly the geographical element in the history of the improvement of the cabbage and the diversification of its types by careful selection and cultivation may escape him, as also in the influence of religious laws and customs on what people eat. But perhaps this is, after all, a matter of definition; and if the reader accepts Brunhes' definition of human geography as explained and illustrated in his "Géographie humaine," then he cannot question the propriety of treating these things in "La géographie de l'histoire." He may still wonder, however, whether in attributing important geographic consequences to "the struggle between the warm waters and the cold waters, the blue waters and the green waters" of the ocean (pp. 150–152) the authors have not, in the first place, overlooked physical characters of the ocean, such as differences in depth, differences in oxygen content of shallow and deep waters, differences in salinity, in suspended sediment, in quantity of microscopic plants and animals, and other factors, some of which affect the observed color differences as well as does temperature, and others of which may profoundly influence, directly or indirectly, the distribution of food fishes and hence man's activities; and whether they have not, in the second place, undervalued geographic factors vastly more important than the temperature contrasts of these waters when they make of them "the essential and determining forces" in the distribution of maritime populations.

## Treatment of Forests and Steppes

When the authors make a mystery of the fact that forested areas are populated more rapidly than steppes (pp. 166–190) and then seek to explain the mystery by showing that, although life on the steppe is easy and comfortable (*sic*) and that in the forest is laborious and trying, the very wealth of effort required to overcome the forest breeds energy and provokes an increase in population—we are quite unable to follow them. There is no mystery in the obvious fact that man tends to populate most rapidly those portions of a new country where rainfall is sufficiently abundant for him to grow plenty of food for his needs (such areas are apt to be forested) and avoids those areas where hard experience teaches him that the rainfall is too scanty to permit the raising of crops (such areas include the steppes). If a region of fairly abundant rainfall happens to be treeless or but scantily forested, and other conditions are favorable, man passes by the forested lands and presses painfully onward to where the conditions of life are easier, as was the case in the rapid populating of our prairie plains when their potentialities had once been realized. On the other hand, if topographic or soil conditions make life in the forested belt unusually difficult, the forest remains sparsely populated, as in much of our Appalachian region. Many Americans unwisely pressed westward beyond the line of twenty inches of rainfall into the region of the steppe but were forced back because conditions of life were there too difficult. The inhabitant of the eastern forest still

enjoys advantages in the form of game, fish, and wild fruits practically unknown to the inhabitant of the steppe; and the western pioneer of today is as noted for his vigor and energy as was ever the clearer of the eastern forest.

## Treatment of Natural Frontiers

The authors' treatment of the subject of natural frontiers (pp. 354–361) is disappointing. They err in limiting the rôle of such frontiers to serving as protective barriers, with the result that their discussion is incomplete and their conclusions in part at least invalidated. Equally erroneous is their assumption that rivers and mountains have no value as military barriers, since they can be passed by determined armies (but at what a price!); and we read the surprising statement that "no European river has served efficaciously as a barrier." Surely they have not read aright the lessons of the Great War. They sometimes confound *mountains* with the line of the *watershed* in the mountains and fail to recognize that both in the recent war and in other historic struggles mountain barriers checked an invasion, even in cases where the invaders passed a short distance beyond the drainage divide. They overestimate the simplicity of the river as a basis for the demarcation of a boundary line and underestimate the difficulties resulting from shiftings of the river's course. These difficulties are real and serious, and they were so far taken into account at the Peace Conference of Paris that the location of more than one international boundary was in part determined by the necessity of avoiding the conflicts to which such changes of river courses give rise. And whether or not one agrees with Huntington's ideas as to the effects of climatic oscillations on human migrations, one will feel that Huntington's arguments are sufficiently serious to deserve a more adequate reply than contrary assertions unsupported by arguments or facts (pp. 227–228).

## Impossibility of National Isolation

It would be wrong to overestimate the importance of these shortcomings. After all, they are matters which in no wise affect the validity of the large lessons the authors seek to teach, nor do they materially detract from the very high value of the treatise. They merely show that "La géographie de l'histoire" should be read carefully and intelligently. The important fact remains that it should be read, not only by geographers, but by every one who seeks light on the troubled problems confronting the world today, whose solution will make the history of tomorrow. All such readers will find Brunhes and Vallaux's work not only of absorbing interest but also of real service in clarifying their ideas on a variety of political and economic questions. And it is in no spirit of levity that we would commend certain pages of this valuable book to those members of the United States Senate who think the future weal of this country depends upon its adhesion to a policy of "splendid isolation:" "It is not only an uninterrupted contiguity [of states] which is

thus established, it is also what we may call an uninterrupted *interdependence*, the threads of which will not loosen in the future; on the contrary they will never cease to grow tighter. Henceforth no state, large or small, can live within frontiers hermetically sealed. . . . Tomorrow there will be no isolation, splendid or otherwise, for any state, no matter how powerful or feeble it may be. The earth, grown too small, will no longer permit anyone to live unto himself. There will be, in the relations between states, a certain imperious obligatory compulsion, either toward co-operation or toward hostility, such as has not hitherto existed. . . . Tomorrow individual relations between states, either in peace or in war, will practically cease to exist. . . . In order to form an organism as strong and rich as possible, the states must co-operate in groups to the end that they may include within their federated territories the whole gamut of natural resources and manufactured products demanded by the growing complexity of social life. It is only through this interdependence, voluntarily established among some of their number, that peoples can escape the universal dependence, and consequently the inevitable subjection, that will be the fate of the isolated" (pp. 423–426).

# GEOGRAPHICAL RECORD

## AMERICAN GEOGRAPHICAL SOCIETY

**Meetings of December, January, February, and March and Elections to Fellowship.** Regular monthly meetings of the American Geographical Society were held at the Engineering Societies' Building, 29 West Thirty-ninth Street, on December 20, 1921, January 24, February 21, and March 21. At the December meeting Mr. William Beebe gave an admirably illustrated lecture on "A Naturalist in British Guiana Jungles," describing the work of the Tropical Research Station of the New York Zoological Society at Kartabo, British Guiana. of which he is director. At the January meeting, after presentation of the annual reports, of the Society (printed below), a timely address on the "Political Geography of the Pacific" was given by Professor Albert Bushnell Hart. At the February meeting Professor A. V. Williams Jackson spoke on "Travels in Persia." Professor Jackson, who has made three research expeditions to Persia, recently revisited that country as a member of the American Committee for Persian Relief. On January 3 under the joint auspices of the American Geographical Society, the Oriental Club of New York, and the Columbia University Institute of Arts and Sciences a lecture was given at the Horace Mann Auditorium by Mr. Henry Lee Shuttleworth, District Officer of the Punjab, on "The People and Scenery of the Western Himalayan Countries between Simla and Kashmir." A selection of photographs and other illustrative material from Mr. Shuttleworth's collections was on exhibition at the Society's building from January 3 to January 5. At the meeting of March 21 Mr. Fred Payne Clatworthy gave a lecture on "Colorado and the Southwest in Natural Colors," illustrated by autochrome slides.

At the last meeting for the season, to be held on April 25, the Society will be honored by Mr. John W. Davis, late Ambassador to Great Britain who will speak on "The Unguarded Boundary."

At the December, January, and February meetings, President Greenough presiding, there were presented with the approval of the Council the names of 96 candidates who were duly elected as Fellows of the Society.

**Annual Reports of the Society.** At the annual meeting of the American Geographical Society, held on January 24 at the Engineering Societies' Building, 29 West Thirty-ninth Street, the annual reports of the Council, of the Treasurer, and of the Special Committee were read as follows:

### Report of the Council

*To the Fellows of the Society:*

The record of the past year has been marked by activity and progress in the established purposes of the Society. The primary effort is directed to the production and publication of scientific and original geographical papers which it is believed will afford not only interest and information to the Fellows of the Society, but will add very substantially to permanent geographic knowledge.

As a necessary corollary to such endeavors no effort is spared to maintain the library as an efficient instrument for scholars and writers. The progress during the past year in cataloguing and in additions exceeds that of any similar period. Additions during the year comprise 1,401 books, 720 pamphlets, 6,700 periodicals, 3,182 maps, 77 atlases. The collection now numbers 59,331 volumes of books and pamphlets and 53,903 atlases and maps.

The labor conditions in the printing trade caused greatly increased delay and expense in production of books and printed matter, but notwithstanding this we have completed the issue and distribution of the two important books notified last year; namely, "Battlefields of the World War: A Study in Military Geography" by Professor D. W. Johnson, and "The New World: Problems in Political Geography" by Dr. Isaiah Bowman. These publications have elicited warm praise from many of our Fellows and from eminent outside sources.

There are now in preparation various issues for the new year, some of which have already emerged from the printer and the distribution of which will receive due notice. We may briefly enumerate some of the titles without dwelling upon the contents, which will be duly chronicled in issues of the *Geographical Review*:

1. "Palisades Interstate Park"—a publication of particular interest and usefulness to the citizens of New York.

2. "The Agrarian Indian Communities of Highland Bolivia"—an intensive study of community organization amongst the primitive inhabitants of that country.

3. "The Position of Geography in British Universities"—a study in educational geography of wide scope and great usefulness in education.

4. "Recent Colonization in Chile"—which deals with the racial composition of the Chileans of today and with colonization methods of the government.

5. "The Rainfall of Chile"—a technical study of rainfall distribution that has influenced settlement.

6. "The Land System of Mexico'—a penetrating study of the evolution of a distinctive system of landownership and use.

7. "Legendary Islands of the Atlantic"—a charming and scholarly book on a classic theme.

8. "The State of Geographical Knowledge in the Eleventh and Twelfth Centuries"—a study of historical geography and the development of geographical thought.

9. "Walk Book of New York"—which promises to be fully as useful as the published booklet on the Palisades Park.

10. "The Face of the Earth as Seen from the Air"—a study in airplane geography that will be fully illustrated.

Announcement has already been made of the forthcoming publication of Bering's Voyages and Steller's Journal, which are related publications and will be issued together. The former will contain Bering's Log Book and a map showing his route.

There is ready for publication in co-operation with the National Research Council manuscript and maps dealing with the soils, vegetation, land classification, and rainfall of Africa.

The Alaska Road Commission of the United States has appropriated funds for the production by the Society of a map of Alaska on a scale of 1 : 1,250,000, a work involving compilations from all published and some unpublished sources, which promises to have high value in the development of the territory.

The publication of the *Geographical Review* as a quarterly periodical has met with unanimous approval. The volume of matter printed for 1921 is not far short of that printed in the monthly numbers of the *Review* in the previous year. The high standard of technical execution and the scholarly character of the articles have been matters of wide comment and assurance is given that the *Review* constitutes one of the three or four best publications of its kind in the world today.

Various other activities of the Society may be briefly alluded to.

The lectures have been well attended and appreciated. The speakers have been as follows: Mr. Robert Cushman Murphy, Dr. Edward L. Stevenson, Dr. Robert F. Griggs, Dr. D. G. Hogarth, Dr. Charles K. Edmunds, Mr. Alan G. Ogilvie, His Serene Highness Albert I, Prince of Monaco, Mr. J. O. P. Bland, Prof. Henry E. Crampton, Mr. William Beebe.

The work initiated in the geography of Hispanic America and Brazil, as described in last year's report, has been actively prosecuted with important and satisfactory results. From time to time there will be published in the *Geographical Review* a summary of activities in this department.

The annual convention of the Association of American Geographers was held for two days in April, 1921, under the auspices of this Society and was the occasion for an interchange of papers and consultation amongst distinguished representatives from various parts of the country. The Annals of the Association, which are published with the cooperation of our Society, maintain their high standard of useful contribution to science.

The Cullum Geographical Medal of the Society was bestowed upon Albert I, Prince of Monaco, for his distinguished scientific work in oceanography.

The Society has been called upon by the Government authorities to assist the Department of Justice in the study of the boundary dispute between Texas and Oklahoma along the line of the Red River for about five hundred miles. This call from the Government is a distinction of which the Society may well be proud and is in line with former service rendered by the Society in the Guatemala-Honduras Boundary dispute and at the Paris Peace Conference.

Mr. W. L. G. Joerg, Editor of the Research Series, was granted leave of absence during

the summer months for study amongst the departments of geography in European universities. He acted also as the Society's representative at the Centenary Celebration of the Geographical Society of Paris and attended the meetings of the Section of Geography and Geology of the British Association at Edinburgh. A report of his work will appear in the July number of the *Geographical Review*.

The number of the Fellows of the Society is 3,850, of whom 404 are Life Fellows.

The report of the Treasurer submitted herewith gives a condensed balance sheet and a summary of the income and expenses of the Society.

The staff of the Society deserves most cordial expression of appreciation for the efficiency of its work.

By order of the Council

PHILIP W. HENRY
*Chairman*

January 19, 1922

## REPORT OF THE TREASURER FOR 1921

### *Receipts and Expenses*

| | |
|---|---|
| On December 31, 1920, there was a balance of income account . . . . . | $465.60 |
| During the year there have been received from annual dues, interest on investments, and sales of publications . . . . . | 67,904.78 |
| | $68,370.38 |
| There has been expended for salaries, house expenses, library, meetings, publications, postage, insurance, etc. . . . . | 80,240.99 |
| Balance carried to Capital Account . . . . . | $11,870.61 |

### *Condensed Balance Sheet*

| | | | |
|---|---|---|---|
| Cash . . . . . | $18,889.30 | Annual dues paid in advance | $2,647.75 |
| Sundry balances . . . . . | 236.20 | Monograph Publication Fund | 3,821.34 |
| Balance of Capital Accounts . | 10,423.25 | Hispanic-American Research Fund . . . . . | 7,618.31 |
| | | Sundry deposits and reserves | 6,400.11 |
| | | Special deposits . . . . . | 9,061.24 |
| | $29,548.75 | | $29,548.75 |

HENRY PARISH
*Treasurer*

## REPORT OF THE SPECIAL COMMITTEE

January 19, 1922

The Special Committee appointed December 15, 1921, to nominate and invite suitable persons to fill vacancies which will occur in the offices of the Society at the date of its annual meeting in January, 1922, respectfully report that they recommend the election of the following gentlemen to the offices designated:

| | | TERM TO EXPIRE IN |
|---|---|---|
| *President* . . . . | John Greenough . . . . . | 1923 |
| *Vice President* . . | James B. Ford . . . . . | 1925 |
| *Recording Secretary* | Hamilton Fish Kean . . . . . | 1925 |
| *Treasurer* . . . . | Henry Parish . . . . . | 1923 |
| *Councilors* . . . | Levi Holbrook<br>Archer M. Huntington<br>William C. Potter . . . . . <br>Charles A. Peabody<br>Philip A. Carroll | 1925 |

Philip W. Henry
W. Redmond Cross
Paul Tuckerman
*Committee*

**Election of Honorary and Corresponding Members.** At the meeting of the Council of the American Geographical Society held on February 16 a notable addition was made to the Society's membership lists in the elections of Honorary and Corresponding Members. No elections to these classes of membership had been held since 1918; and the present list, which is unusually long, may also be described as unusually representative and distinguished. The list follows:

## HONORARY MEMBERS

MAJOR GENERAL ADOLPHUS WASHINGTON GREELY, of the United States Army (retired). General Greely is one of America's most distinguished Arctic explorers. His most important exploratory work has been described in "Report on the Proceedings of the United States Expedition to Lady Franklin Bay, Grinnell Land." He is the author of the "Handbook of Polar Discoveries" and of many papers on the climatology of the United States.

COLONEL SIR THOMAS HUNGERFORD HOLDICH, K. C. M. G., K. C. I. E., C. B. Colonel Holdich is a Vice-President of the Royal Geographical Society. He was formerly Superintendent of the Frontier Surveys, India, on which country he has written several notable works. He is an authority on boundary problems, his best known writings in this field being "Countries of the King's Award," "Political Frontiers and Boundary Making," and "Boundaries in Europe and the Near East."

LUCIEN GALLOIS, professor of geography, University of Paris. M. Gallois is one of the senior geographers of France. His earlier interests were in historical geography, in which domain "Les géographes allemands de la renaissance" is his chief work. He has since devoted himself to phases of human and regional geography, to which period belong "Régions naturelles et noms de pays: Étude sur la région parisienne" and numerous papers. Professor Gallois is one of the editors of the *Annales de Géographie*.

## CORRESPONDING MEMBERS

GUNNAR ANDERSSON, professor of economic geography at the College of Commerce, Stockholm. Professor Andersson is president (1922) of the Swedish Anthropological and Geographical Society and editor of the Society's two periodical publications, *Ymer* and the recently founded *Geografiska Annaler*. He is the author of notable contributions in the field of plant geography, more particularly on the evolution of the post-glacial vegetation of Scandinavia.

CHARLES RAYMOND BEAZLEY, professor of history in the University of Birmingham, England. Professor Beazley is a member of the Council of the Royal Geographical Society. His work in historical geography is especially known through "The Dawn of Modern Geography."

JOSÉ J. BRAVO, Director of the Cuerpo de Ingenieros de Minas y Aguas, Lima, Peru. Señor Bravo is the author of many technical papers in earth sciences and an ardent worker for the promotion of geographical knowledge of Peru. He is president of the recently organized Peruvian Association for the Advancement of Science.

JAMES HENRY BREASTED, professor of Egyptology and oriental history and director of the Haskell Oriental Museum of the University of Chicago. Dr. Breasted's appreciation of the geographical factor in history is admirably illustrated in his important textbook, "Ancient Times: A History of the Early World."

JEAN BRUNHES, professor of geography, Collège de France, Paris. Professor Brunhes is known as one of the chief interpreters of human geography, author of that already classic work, "La géographie humaine." He has recently written two other important books in his chosen field—"Géographie humaine de la France" (Tome I of "Histoire de la nation française") and, with Camille Vallaux, "La géographie de l'histoire" (reviewed in this number of the *Geographical Review*).

HENRY CHANDLER COWLES, professor of botany at the University of Chicago. Dr. Cowles is the author of a "Textbook of Plant Ecology" and a student of many practical ecological problems.

BARON GERARD DE GEER, professor of geology at the University of Stockholm. Baron De Geer's chief work has been done in the field of post-glacial chronology, and his studies embrace the Fenno-Scandinavian realm and northeastern North America. He has also carried out geological and geographical investigations in Spitsbergen.

ALBERT DEMANGEON, professor of geography at the University of Paris. M. Demangeon,

well known as the author of a model regional geography, "La Picardie," is especially interested in the economic phases of geography. His striking study of the effects of the War on world commerce and industry has been published in Europe under the title "Le declin de l'Europe" and in America as "America and the Race for World Dominion."

GUILLAUME GRANDIDIER. M. Grandidier is secretary of the Geographical Society of Paris and editor of its journal, *La Géographie*. The chief sphere of his work is Madagascar. He has made important contributions to our knowledge of the natural history, history, and geography of the island. These include "Madagascar au XIXe siècle: Géographie, ethnographie, et zoologie;" "Bibliographie de Madagascar;" and, in collaboration with M. Alfred Grandidier, "Collection des ouvrages anciens concernant Madagascar" and "Ethnographie de Madagascar."

DAVID GEORGE HOGARTH, C. M. G., Keeper of the Ashmolean Museum, Oxford, England. Dr. Hogarth is intimately acquainted with the Near East, and, while his interests are primarily archeological, he has made notable contributions to the geography of that region, more particularly in "The Nearer East" and "The Penetration of Arabia." He is a member of the Council of the Royal Geographical Society.

MARK JEFFERSON, professor of geography at the State Normal College, Ypsilanti, Michigan. Professor Jefferson's extensive and original geographical writings are chiefly concerned with human geography and especially the distribution of population. He was leader of the American Geographical Society's expedition to the A. B. C. countries in 1918. The first part of the report of his investigations has been published in the American Geographical Society's Research Series as "Recent Colonization in Chile" and "The Rainfall of Chile."

CURTIS FLETCHER MARBUT, in charge of soil survey of the Bureau of Soils, U. S. Department of Agriculture, Washington, D. C. Dr. Marbut is a student of the application of physiography to the distribution and use of soils. He is joint author of a work on the soils of Africa to be published shortly by the American Geographical Society in collaboration with the National Research Council.

OLINTO MARINELLI, professor of geography at the Royal Institute of Higher Studies of Florence. Professor Marinelli is one of the foremost geographers of Italy and one of the joint editors of the *Rivista Geografica Italiana*. He has done important work in both physical and human geography. Many of his studies relate to the Italian Alps.

JOHN LINTON MYRES, O. B. E., Oxford, England. Professor Myres has devoted himself primarily to the study of Mediterranean archeology in its geographical setting. He is most widely known as the author of "The Dawn of History." He is a member of the Council of the Royal Geographical Society.

CHARLES RABOT. Dr. Rabot is a member of the Council of the Geographical Society of Paris and for eighteen years was editor of its journal, *La Géographie*. He is the foremost French authority on the geography of Scandinavia and the Arctic and the author of several books and numerous papers on these regions. He has also specialized in glacial studies.

SIR AUREL STEIN, K. C. I. E. Dr. Stein is Superintendent of the Indian Archeological Survey. His several explorations in Central Asia have resulted in notable advance in our knowledge of the early relations between China and the Western world. His latest publication is the monumental work "Serindia: Detailed Report of Explorations in Central Asia and Westernmost China."

LIEUTENANT COLONEL JEAN TILHO, of the French Army. For many years Commandant Tilho has been engaged in the pacification and administration of territories in the central Sudan. His important investigations of the period 1906–1909 have been published as "Documents scientifiques de la mission Tilho." During 1912–1917 he conducted a remarkable series of explorations in the regions of Tibesti, Erdi, Borku, and Ennedi, northeast of Lake Chad.

FREDERICK JACKSON TURNER, professor of history, Harvard University. Dr. Turner is a member of the Harvard Commission on Western History and of the National Board for Historical Service. He is the author of "The Frontier in American History" and "The Rise of the New West." His studies are especially distinguished by the application of geographical science to historical research.

ROBERT DECOURCY WARD, professor of climatology at Harvard University. Professor Ward is one of the leading authorities on climate in the United States. He is well known as the author of "Climate: Considered Especially in Relation to Man" and as the translator of Volume I of Hann's "Handbuch der Klimatologie."

## NORTH AMERICA

**Stages in the Development of the Sheep Industry in the United States.** The history of pastoral industry in the United States is in no small degree a history of the frontier. The part played by cattle raising is well known: that of sheep rearing is less familiar, and it may be of interest therefore to summarize the paper "A Brief History of the Sheep Industry in the United States" by L. G. Connor in the last (1918) Annual Report of American Historical Association (Washington, D. C., 1921, Vol. 2, pp. 93–197).

In the first stage of the industry from its beginnings in 1609 to 1808, when the Embargo Act and its successor, the Non-Intercourse Act, checked importation, sheep raising was limited to the small flocks necessary to supply the wool which practically every household used for its own manufacture of coarse woolen cloth. From 1808 to 1830 the demand for fine woolens, formerly obtained from Europe, led to the establishment of many woolen mills; but the repeal of the Acts did much to counteract the stimulating effect of the application of power and the introduction of machinery into the American mills. Recovery came, however, with the return to normal conditions in European affairs in 1830; and the next decade and a half was marked by rapid growth of the industry in the East. It was the period of supremacy for the eastern wool grower, for the West as yet was limited to production for home needs.

By 1845, however, the western migration of the wool sheep had begun on a large scale. The low cost of wool transport as compared with that of other farm products—wool was a profitable product 200 miles from the shipping point—gave such an impetus to the industry in the West that the East, in face of rising land values and increasing feeding costs, began to yield to competition. Decline in the flocks of the East was also accompanied by a characteristic change in the eastern sheep to the mutton type. The rapid advance of the industry in the Middle West during the period 1840 to 1850 slackened in the succeeding decade. The pioneer enterprise now experienced the competition of other branches of husbandry encouraged by the improvement of transportation facilities and by the opening of foreign markets. A particular stimulus was afforded by the market loss of Russian grain during the Crimean War. During the next few years the trend was reversed. The Civil War brought an increased demand for woolen goods to which both East and West responded by a rapid increase in the number of sheep. At the same time wool production on a large scale had commenced in the southern hemisphere—in Argentina, South Africa, and Australasia—and the close of the war brought a sharp decline in the price of wool and a reduction in the size of the flocks, especially in the East and in the North-Central States.

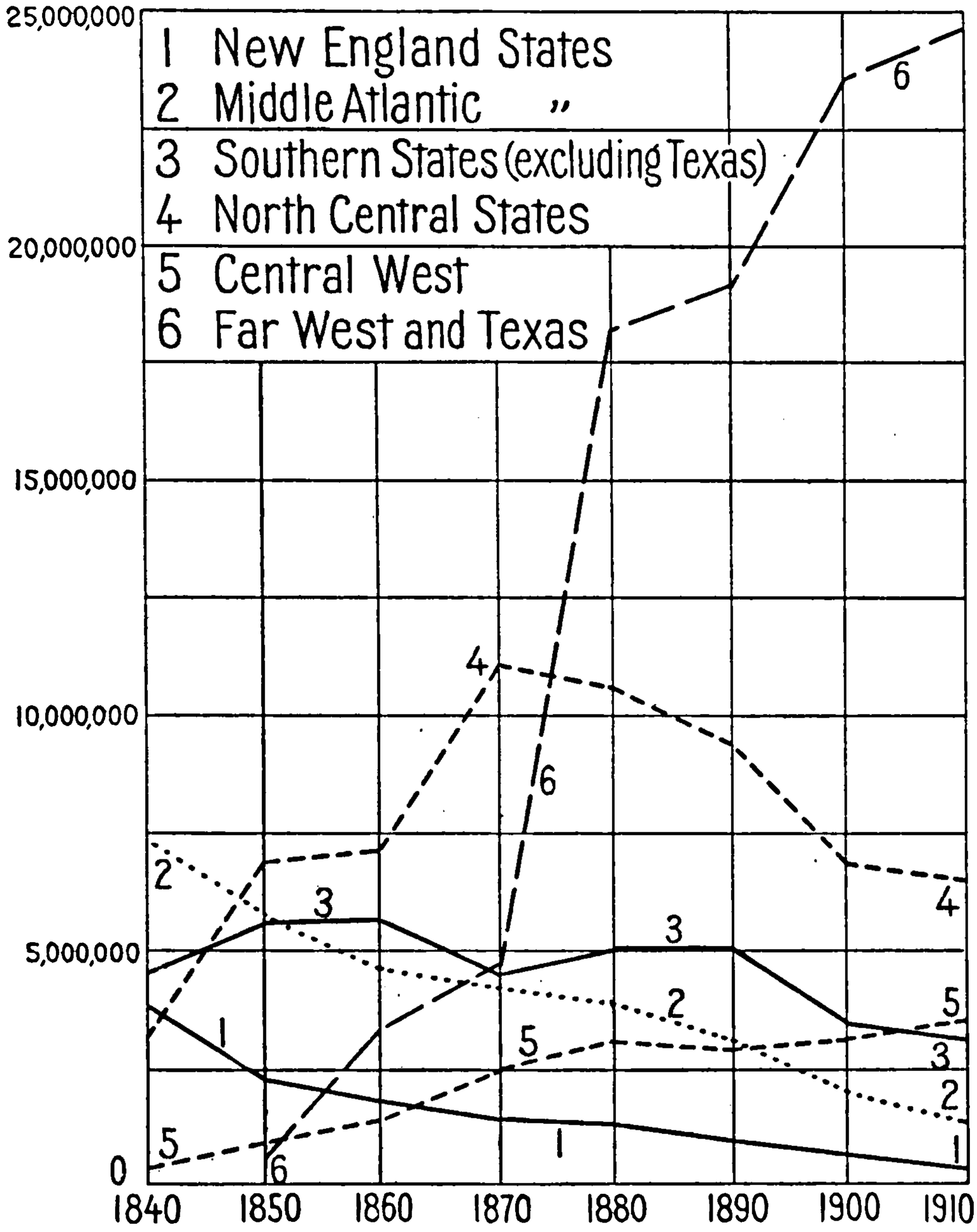


FIG. 1—Graph showing the number of sheep in the United States by major divisions at successive decades from 1840.

Expansion of the frontier, which had suffered temporary arrest, now entered on the last phase, and with it the last westward shift of the sheep industry. This stage was essentially different from the previous ones because of differences in natural conditions—the range where sheep rearing was a major enterprise as opposed to the farm where it was a minor activity. The greatest gain in the industry was made between 1870 and 1880 when the wave of expansion slackened, in part because of lower wool prices, in part by reason of the more fundamental cause, that it had been started in areas which proved more favorable for other activities, and also through overstocking of the range.

After 1890 the industry became concentrated in the Rocky Mountain region where the range conditions and the remoteness from markets gave this the advantage over other industries.

The frontier has gone: there are now no more great areas of unused land suitable for sheep, and the present grazing areas of the ranges are stocked to capacity. This capacity may indeed be increased by improved management, but such growth is necessarily slow. It seems that the industry has reached a turning point, and a movement of sheep "back to the farm" is likely to be initiated.

**Economic Effects of the New England Ice Storm of November 26–29, 1921.** What is believed to have been the worst ice storm in the history of New England occurred in that section in the latter part of last November. The storm, which continued unabated for over seventy hours, caused widespread destruction in that region. The sleet intermingled with rain froze to everything it struck; and trees, wires, poles, and buildings became covered with a thick glaze of ice. This glaze covering became thicker and thicker, and under the ever-increasing burden trees and poles groaned and creaked in the wind. Huge limbs, unable to stand the strain, crashed to the ground, and in some instances whole trees were uprooted. Elms, maples, and poplars were particularly heavy sufferers, while oaks and ashes seemed to weather the storm the best. Some idea of the destruction wrought upon trees can be had from the fact that in the city of Worcester, Mass., alone "between 7,500 and 8,000 trees were so badly damaged by the storm that they will have to be taken down at once and that from 5,000 to 7,000 others were so badly mutilated that their replacement must take place within a period of five years."

Trolley wires sagged and snapped, branches and poles fell across the tracks, leading to a complete suspension of service. So great was the damage that in central Massachusetts it was three weeks before trolley service reached a normal state again. Railroad service also was seriously disrupted. Towers carrying high tension power wires were also felled, and this led to many communities being without power. In those places the industries which depended entirely upon electricity were obliged to close until service could be restored. Over 40 cities had their electric lighting systems put out of commission by the storm.

Telegraph and telephone systems were badly crippled. Hundreds of poles and miles of wire fell, and both local and long distance services in many instances were completely demoralized. Hundreds of unskilled men were set to work after the storm cleaning up the débris. Experienced repair crews were brought in from distant points, and in the first ten days after the storm they had strung 100,000,000 feet of wire in an effort to link up New England with the rest of the world. Telephone officials state that the storm will cost them nearly $1,500,000, while telegraph men say that their loss is equally as great. Altogether it is estimated that property was damaged to the extent of $3,000,000.

Regarding the cause of the storm G. F. Howe and C. F. Brooks say, "The unusual duration of this ice storm seems to have been due to a large supply of cold air flowing southwards, and of warm air going northwards above it. The cold wind at the surface, as is usual when sleet or ice storms occur, formed a barrier over which the warm wind had to rise. It was this rising and the consequent cooling by expansion which reduced the vapor capacity of the wind aloft and thus produced rainfall. The two currents in this case were surprisingly well balanced" (*Bull. Amer. Meteorol. Soc.*, Vol. 2, 1921, p. 140).

GUY HARVEY BURNHAM

## SOUTH AMERICA

**A Vegetation Map of Venezuela.** A welcome addition to the scant data on Venezuelan vegetation has been made by Henri Pittier, now Director of the Commercial Museum of Caracas. On a map (Mapa ecológico de Venezuela que demuestra las zonas naturales, los

cultivos, las viás de comunicación y los principales centros mineros, etc.) of scale 1 : 2,000,000 natural vegetation is represented by five green tints (not too easy to distinguish) and cultivation by two yellow tints. Other useful data shown are communications and mining centers, and the map is accompanied by a descriptive text (Esbozo de las formaciones vegetales de Venezuela con una breve reseña de los productos naturales y agrícolas, Caracas, 1920).

The areas ascribed to the main types of vegetation differ considerably from other recent estimates—a higher figure is given to the wooded area while that of the land under cultivation is much reduced. On a total area of some 403,000 square miles (1,043,900 sq. kilometers, Almanach de Gotha) the percentages are woodland 52, savana 45, *páramos* 0.35, cultivated land (not including artificial pastures) 0.4. The very small amount of land under actual cultivation, about 1,610 square miles, is striking. The higher figures of earlier estimates may be due to inclusion of other areas of cultivable land or land that has been once under cultivation, for in common with other countries of tropical America the *conuco* system is general in Venezuela, and there are considerable areas of abandoned clearings (compare the article on "The Forests of the Dominican Republic" in this number of the *Review*). Not less striking than the small area devoted to agriculture is the limited use of the forests and grasslands. Their potentialities have long been recognized in a general way, but they still remain almost unknown scientifically.

The forested areas include four types, dry woodlands, monsoon forest, tropical rain forest, temperate forest, to which might be added a fifth, the mangrove forests fringing the Orinoco delta. The dry woodland exhibits two facies, thorn forest and chaparral. Thorn forest (*espinares*) occurs at various points along the coast from the peninsula of Goajira to Paria and on Margarita and the adjacent islands. Chaparral is found in very dry districts of the interior, usually at elevations below 1,000 meters, and in proximity to the savana into which formation it merges without sharp distinction. At times it is difficult to distinguish the chaparral from the *rastrogos*, second growth vegetation on abandoned clearings. It corresponds on a small scale with the *caatingas* of Brazil. During the rainy season the dry woodlands exhibit a luxuriant verdure, but the appearance of aridity is not entirely lost: it is expressed by several permanent features—the reduced size of the trees, the relative thinness of the undergrowth, and the presence of such forms as the cacti.

The monsoon forests are a transitional formation between the dry woodland and the rain forest. In the dry season they present an appearance similar to the former; in the rainy season to the latter. The monsoon forest is, however, distinguished from the dry woodland by the abundance of lianes and woody vines and the larger size of the trees. It is differentiated from the rain forest by the seasonal change of aspect, for in the dry season a number of the trees completely lose their foliage. This type occupies about two-thirds of the forested area of Venezuela. It covers the maritime cordillera between the thorn woodland and the temperate forests and a broad belt at the foot of the Andes and the western sierras. Its maximum development, however, occurs in Venezuelan Guayana.

The tropical rain forest occupies the Andean slopes south and southeast of Lake Maracaibo, the lower valley of the Tocuyo, and a belt in the south from the Rio Negro and Upper Orinoco basins along the divide of the Guayana highlands. This type has the usual characteristics of the storied tropical rain forest. Emphasis must be laid on the variation of forest composition from place to place regarding which we are almost completely ignorant.

No definite altitude can be fixed as the lower limit of the temperate forest. It is best described as coincident with the zone of maximum precipitation, the cloud zone. It is more varied than the tropical rain forest, and a number of deciduous species are included in its composition. It presents considerable similarity to the monsoon forest from which, however, it may be distinguished by the nature of the ground cover, composed characteristically of tree ferns and including genera of small palms (*Geonoma* and *Chamaedorea*). It attains a considerable development in the Andes and the coast cordillera, but, though the chief towns and agricultural districts occupy clearings in this forest, its characteristics remain little known.

In the Andes and the highest peaks (Silla de Caracas and Pico de Naiguatá) of the coast cordillera the temperate forest gives place at higher elevations to *páramos* whose xerophytic vegetation is comparatively well known.

The common picture of the famous llanos as vast monotonous stretches of grassland is far from correct. As Codazzi has pointed out, there are great variations in different parts. The main types may be shortly described. The *pajales* or *pajonales* extend from the slopes

of the coast cordillera to the center of the llanos. They appear as a thick grassy cover more or less interrupted by bands of monsoon forest and are described as "parkland" or "gallery forest" according to the predominance of savana or woodland. The parklands are best developed towards the west on the foothills and the gently sloping plain traversed by the middle courses of the affluents of the Apure. They offer conditions highly favorable for human settlement—abundant water, fertile land, natural pasture, though the lower parts may suffer from inundation. The gallery forest type is best seen in Alta Guayana along the Caura and other streams. The *mesas* offer a sharp contrast. They are sandy, permeable wind-swept areas, without trees, without water, scantily covered with a herbaceous vegetation. The *mesas* constitute the more elevated portions of the eastern llanos north of the Orinoco (Sievers distinguishes them on his vegetation map of Venezuela, *Petermanns Mitt.*, Vol. 42, 1896). The *morichales* are so named from the occurrence of the moriche palm (*Mauritia flexuosa*). This type borders the left banks of the Apure and Orinoco to near the delta. The soil is humid or swampy, and the vegetation remains green and fresh in the driest season; whence these are concentration points for cattle in search of water and pasture. The southwestern part of the savanas between the Apure and the Meta presents the aspect commonly associated with the llanos, vast level stretches, grass-covered, broken only by occasional groves. A tree border is usually lacking from the watercourses, and during the rainy season great areas are inundated.

These are the main types of the savana, but the transition forms are infinitely varied. Of details regarding the vegetation nothing is known; though such knowledge would form the basis for a serious attempt to utilize the enormous grazing resources of the llanos and would doubtless help to throw light on the vexed problem of their origin (see Eugene Van Cleef: Rainfall Maps of South America, *Monthly Weather Rev.*, October, 1921).

**Chilean Ethnological Expeditions to Tierra del Fuego.** The fast vanishing tribes that peopled the archipelago south of the Strait of Magellan have been the subject of study by several scientific parties in recent years. (For a complete summary of the results of these and earlier investigations see J. M. Cooper's "Analytical and Critical Bibliography of the Tribes of Tierra del Fuego and Adjacent Territory," in *Bur. of Amer. Ethnology Bull. 63*, Washington, D. C., 1917.) Stimulated by the example of scientists from other countries and having their attention attracted to the region by the celebration of the four-hundredth anniversary of Magellan's discovery of the "Land of Fire," Chileans themselves have recently sent two small expeditions to study the Indians of the region (Martín Gusinde: Expedición a la Tierra del Fuego, and *idem:* Segundo viaje a la Tierra del Fuego, *Publs. Museo de Etnología y Antropología de Chile*, Vol. 2, 1920, pp. 9–43 and 133–163, Santiago).

Señor Gusinde's primary object was to investigate the customs, myths, and language of the two tribes, the Onas and the Yahgans, or Yámanas as he calls them, using the term which they themselves employ. The former are guanaco-hunting people that now have been forced into the forested districts in the southeastern part of the main island; the latter, canoe folk who live in the numerous channels to the south. (Compare the descriptions by C. W. Furlong in the *Geogr. Rev.*, Vol. 3, 1917, pp. 1–15 and 169–187.) Ethnological collections for the Museum in Santiago were also made. Gusinde visited the temporary encampments of the few survivors of these two tribes and was particularly fortunate, it would seem, in that he was able to witness and even to participate in some of the ancient ceremonies still observed by the Yahgans (Yámanas). By his intimate contact with them during several months he was also enabled to collect many data regarding their myths and traditions. The papers above referred to contain, however, little more than the account of the expeditions, since the scientific results are to be published at a later date.

Gusinde also adds somewhat to existing knowledge regarding the third tribe of Fuegian Indians, the Haush, who formerly occupied the extreme southeastern end of the main island, but of whom there are said to remain only two or three representatives. He promises to publish his conclusions regarding the ethnic differences that exist between this tribe and the Onas, as also an opinion concerning the probable origin of the former. Brief mention is made of the Alaculoofs, the other canoe tribe that inhabits the channels of western (Chilean) Patagonia and some of the water passages in western Tierra del Fuego, among the least known of all the tribes of America. (Other recent contributions to the study of these last-mentioned people are, Aureliano Oyarzún: Los indios Alacalufes, *Publs. Museo de Etnología y Antropología de Chile*, Vol. 2, 1920, pp. 165–170; and R. Lehmann-Nitsche: El grupo lingüístico Alakaluf de los canales magallánicos, *Rev. Museo de la Plata*, Vol. 25, 1921, pp. 15–69.)

Of particular geographical interest are Señor Gusinde's corrections of the map of Tierra del Fuego issued by the Chilean Oficina de Mensura de Tierras (1 : 500,000). He states that there exists, near the headwaters of the Rio Grande, a lake called Lago Blanco (longitude 60° 5′ W., latitude 53° 58′–54° 12′ S.) which measures about 35 kilometers in length and more than 15 kilometers in width. It appears to be drained by the Rio Blanco, one of the upper tributaries of the Rio Grande, and to receive the waters of the Rio Cochrane (which the map shows flowing directly into the Rio Grande) which in turn drains another lake, Lago Chico, that lies south of Lago Blanco. The river that appears on the map as Rio Cochrane, Gusinde says, is really the Rio Catalina. He also asserts that Lago Lynch is far larger than shown on the map, being some 20 kilometers long, and that it lies 20 kilometers farther west than indicated. Since all of the northern part of the main island is being taken up as sheep ranches, and whites are settling also at many points farther south, as well as upon various smaller islands, it is evident that many further details can soon be inserted in the blank spaces on these maps.

## POLAR REGIONS

**Norwegian Explorations in Spitsbergen, 1919, 1920, and 1921.** In my article "The Norwegians in Spitsbergen" (*Geogr. Rev.*, Vol. 8, 1919, pp. 209–226) a summary notice was given of the scientific work being carried on by Norwegians in West Spitsbergen. This work includes the topographic and geological mapping of the coal-basin regions and a hydrographic survey of the west coast, of which the prime object was to facilitate navigation of the coal-carrying vessels. Under the direction of M. Adolf Hoel, who has been one of the leaders of the annual expeditions since 1911, the surveys have been continued in 1919, 1920, and 1921 and are now practically completed. A résumé of the most important results has been received in a communication from M. Hoel.

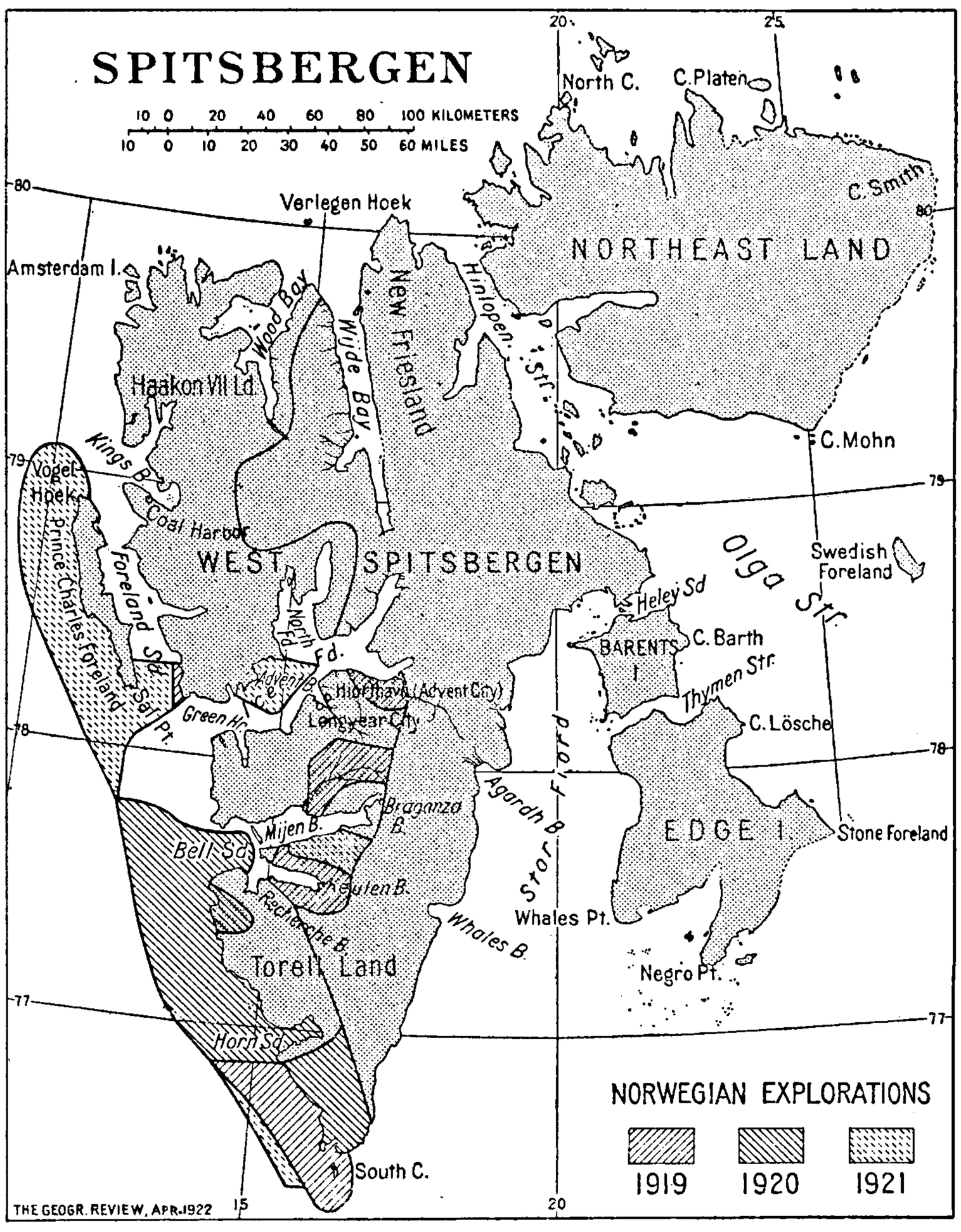


FIG. 1—Map of Spitsbergen showing the area covered by the Norwegian expeditions of 1919, 1920, and 1921. All of the territory west of the line running from the northwestern corner of Wijde Bay to the east of South Cape has now been surveyed by the series of Norwegian expeditions of 1906–1921. The expeditions of 1906 and 1907 were carried out under the Prince of Monaco, the later expeditions were supported by a subvention from the Norwegian government and by private enterprise.

Ice conditions were very favorable in 1919; the west coast indeed had never been so ice-free since 1898. Only during two short periods was drift ice encountered and then only in small quantities. During the summer of 1920 the sea remained almost equally ice-free. From July 6 to August 31 M. Hoel saw only some few masses of ice carried by the northward-setting current. This favorable situation was prolonged during the succeeding winter (1920–1921), which proved to be an absolutely abnormal season. During this entire season the west coast was practically ice-free. Even the fiords were generally open: from

time to time a layer of ice would form on the surface but only to break up and disappear during some subsequent storm. As early as April 13 a steamer was able to reach the coal wharf of Kings Bay (78° 55′ N.).

On the other hand, by the middle of June ice originating on the east Spitsbergen coast had doubled South Cape and arrived on the west coast, where it remained all summer extending northward to the southern point of Prince Charles Foreland. Broken up by numerous channels it offered, however, no very great difficulty to navigation. This extraordinary seasonal distribution of ice appears to be due to the predominance of easterly winds during the winter of 1920–1921 and the succeeding summer. During the winter the pack ice from the northern and eastern parts of the Barents Sea was frozen fast and could not be carried to the west coast by the easterly winds, but, when the spring break-up came, it moved westward under the influence of the winds—a movement general throughout the polar seas north of Europe.

During the three seasons of 1919–1921 M. Hoel and his colleagues were engaged in the region extending from Ice Fiord to South Cape. Here they surveyed 386 square miles in 1919 and 579 square miles in 1920 but in 1921 only 154 square miles on account of the impediments offered by the great quantity of ice. Thus the survey of the west coast of West Spitsbergen is almost completed, and in the near future Norway will publish a map on the scale 1 : 100,000 or 1 : 200,000 from the northern coast to the most southerly point of the island with a breadth of from 13 to 62 statute miles. A chart of the west coast from Cross Bay to South Cape will also be constructed.

As regards geology considerable results have been obtained during these last three years. The geological map of the coal basin of central Spitsbergen on the scale 1 : 50,000 has been completed from the west coast up to a line from Björndal (a valley opening on to the eastern shore of Ice Fiord to the southwest of Advent Bay) to the mouth of Conway valley in Van Mijen Bay. A geological map of the coal basin on the southern shore of Kings Bay on the scale of 1 : 10,000 has also been made.

On the most recent and most complete geological map of Spitsbergen (Geologische Kartenskizze von Spitsbergen . . . von A. G. Nathorst in his "Beiträge zur Geologie der Bären-Insel, Spitzbergens und der König-Karl Landes," *Bull. Geol. Inst. of Upsala*, Vol. 10, 1910) the entire coast zone between Horn Sound and South Cape is represented as pertaining to the Hecla Hook stage (Lower Silurian, regionally metamorphosed). The field work of 1919 and 1920 has shown that this zone is constituted by less ancient and more varied formations. Besides the Hecla Hook stage Carboniferous, Permian, Triassic, Jurassic, and Cretaceous deposits are represented. Another result no less important is the discovery of crinoids in the Hecla Hook stage, thanks to which it is now possible to assign a definite age to this formation. It has also been ascertained that the Devonian, which in this part of Spitsbergen has been known only from an outcrop on the southern shore of Horn Sound, occupies a relatively extended area towards the south.

In the southern part of the west coast Quaternary shore lines were observed at elevations of 1,100 feet where previously they had not been recognized at elevations above 460 feet.

CHARLES RABOT

**British Exploration in Spitsbergen in 1920.** In the July, 1921, number of the *Geographical Journal* J. M. Wordie describes the results of his work in Spitsbergen. The first few weeks of the 1920 season were spent in Prince Charles Foreland, the classic ground of Dr. Bruce's explorations. A noteworthy feature of the field work was the ascent of Mt. Monaco, 3,450 feet, whence light was gained on several geological problems regarding both the central mountain group of which this peak is the loftiest member and the island as a whole.

On July 22 the expedition left for Stor Fiord, the great waterway separating Barents and Edge Islands from the main island. The fiord is usually difficult of entry until late summer. With the commencement of the break-up of the polar pack drift ice is carried westward past the mouth of the fiord; a portion swings in and is held there until driven out by northeasterly winds. Such were conditions in 1919, and they appear to be usual. In 1920, an abnormal year (see note on Norwegian Explorations above), the waters were very open, permitting visits to many points on the shores. Among the sections visited were Barents and Edge Islands where it was found that, contrary to general belief, the ice covering is of small extent, being confined to the central and eastern portions; "for

the rest both islands are cut up by wide, moderately fertile valleys, which afford excellent feeding ground for the small remaining stock of reindeer."

One object of the visit to Stor Fiord was revision of the coast line as laid down on the Admiralty Chart which is based on the observations of Nordenskiöld in 1864 (the topographic results of the Russian expedition to measure an arc of meridian in 1898–1902 have never been published and presumably must be regarded as lost). The results accomplished here included elimination from the map of the "low flat island" off Whales Bay, an error traceable to the ancient Dutch charts. Depths of 91 and 75 fathoms were found on the site of the mythical island.

Following the description of the work done in Stor Fiord Mr. Wordie makes some comments on the glaciation of Spitsbergen. Adopting the classification of R. E. Priestley in the Scott Antarctic Expedition memoir on glaciology (now in course of publication), he summarizes it thus: "Spitsbergen is covered in the higher parts by sheets of highland ice having their outlet towards the coast as valley glaciers; as a rule these end as such, but in exceptional cases piedmonts and allied ice-formations are developed. This represents the diminished stage of a much more intense glaciation, and if it is considered desirable can be called the 'Spitsbergen stage' of the glacial cycle." The great extent of former glaciation may be considered proved by the accumulated evidence of such phenomena as high-level erratics and raised beaches (steady rise in the land being correlated with steady decrease in the ice of the interior). Topographical evidence is largely lacking, for under the frigid climate rapid frost weathering and the consequent accumulation of talus tend to a speedy obliteration of glacially molded contours. The opinion is expressed that, with local advances, retreat of the glaciers has been constant since the period of the last great ice flood. At present they are in retreat with few exceptions.

On coal mining, which promises to be the dominant industry in the future of the island, Mr. Wordie quotes some recent and suggestive figures. Coal is now mined at Kings Bay, Cape Boheman, Advent Bay, Green Harbor, and Braganza Bay (head of Van Mijen's Bay). In 1919 some 90,000 tons were exported, and it was expected that the figure for 1921 would reach 200,000 tons. The deposits are estimated at 9,000,000,000 tons, sufficient to supply the Scandinavian and other northern markets for many years. Cost of transportation—which is at present very high—will be an important control of output.

## PHYSICAL GEOGRAPHY

**Forecasting the Crops from the Weather.** In an earlier note (*Geogr. Rev.*, Vol. 11, 1921, p. 295) mention was made of the fact that the yield of cotton can be more accurately forecast from mathematical analysis of weather factors than from the reported condition of the crop itself. And this seems to be true of most crops. The yields of a crop in the various years of record are compared with temperature and rainfall conditions in each of the months or selected combinations of months during and preceding the growth of the crop. The relations found may then be used as factors or additive elements in arriving at an idea of the probable yield, the estimate becoming better and better as the successive critical periods are passed. R. H. Hooker, who in 1907 made a successful forecast of England's crops through the use of weather data, chose in his presidential address before the Royal Meteorological Society to discuss the history, present status, and outlook in "Forecasting the Crops from the Weather" (*Quart. Journ., Royal Meteorol. Soc.*, No. 198, Vol. 47, 1921, pp. 75–99). There are two bases on which such forecasts can be made: one is periodicity, and the other, the known effects of weather preceding or during the growing season. Our knowledge of cycles is as yet too indefinite to allow forecasts of value to be made year after year. One of the troubles seems to be, as Hooker points out, that there are too many cycles of varying period operative at the same time.

Nevertheless, Professor H. L. Moore has brought forward strong evidence in support of an 8-year cycle ("Generating Cycles Reflected in a Century of Prices," *Quart. Journ. of Economics*, Vol. 35, 1921, pp. 503–526, and "The Origin of the Eight-Year Generating Cycle," *ibid.*, Vol. 36, 1921, pp. 1–29). After establishing the closeness of the relation between crop yields and prices and showing for each during the last few decades the likelihood of the existence of an 8-year cycle, in England, France, and the United States, he extends the period of his investigation back to 1818 on the basis of wholesale prices (Sauerbach's indices), and to 1760 by the use of the price of grain (Poynting), both in Great Britain, and finds the same 8-year cycle extending back at least 160 years. The cycle, it appears, is a combination

of one of 7.38 and another of 8.73 years. For this apparent cycle in crop yields and the necessarily corresponding one in prices there should be a meteorological cause. Analyzing the rainfall of May and June in the Dakotas, and annual rainfall in the Ohio Valley and in Illinois, Professor Moore finds an apparent 8-year cycle corresponding to that in crop yields. He cites the 7.3-year cycle (cf. the 7.38-year component of the 8-year cycle) in the rainfall-controlled annual growth of trees on the central plateau of Arizona. He also points to the 8-year periodicities in winter barometric pressure in central Europe and to the apparent 8-year period in the pressure of the United States. The crests of the 8-year pressure, rainfall, and crop-yield cycles in the United States and Europe have come generally in the years 1874, 1882, 1890, 1898, 1906, and 1914, or a year earlier. As it is reasonable to expect a cosmical cause for congruent cycles found in North America and Europe, Professor Moore calls attention to the 8-year period in the distance between Venus and the earth, Venus having been nearest us in the years 1873, 1881, 1889, 1897, 1905, 1913, and 1921. While conjunctions of these two planets occur every 1.6 years, it is only at every fifth conjunction, or every eight years, that Venus is nearly or actually between the sun and the earth, owing to the fact that the orbits of Venus and the earth do not lie in the same plane. How this could affect the earth's weather is a difficult question: Professor Moore suggests that since Venus always has the same face to the sun, the resulting perpetual tempest on that planet, from the cold side to the hot one and return may have some effect on the passing solar radiation, and therefore on the earth's weather.

The results of a searching and highly suggestive investigation of economic cycles in western and central Europe have just been published by Sir William H. Beveridge ("Weather and Harvest Cycles," *Econ. Journ.*, Vol. 31, 1921, pp. 429–452). Instead of an 8-year cycle a 15.3-year cycle and especially its double, a 30.6-year cycle, and still longer ones are indicated. After having discovered the 15.3-year cycle in exports from Great Britain, the author found it confirmed by harmonic analysis in records of European wheat prices since 1550. In seeking an explanation, he shows that this cycle probably arises from a temporary combination of two or more shorter ones, namely: cycles of 4.374, 5.11, and probably also 2.74 and 3.71 years. The first and last correspond to well-known periods in sun spots and solar prominences, respectively, while the other two are in evidence in meteorological records. It may be noted here that the 7.38-year and 8.73-year cycles, which Professor Moore thinks may be factors of the apparent 8-year cycle, are almost exactly double the 3.71-year and 4.374-year cycles, respectively. Harmonic analysis confirms the supposition that there is an elemental cycle of 5.11 years in wheat prices but does not offer convincing proof for the 4.374-year cycle. Important conjunctions of the four short cycles occur at intervals of 123, 148, 271, and 608 years, which are strikingly apparent in European famines during the past thousand years. It seems that the effects of these cycles taken individually are not very important, e.g. plentiful rainfall accompanying the crest of a cycle acting alone may produce an excellent crop, whereas the excessive rainfall on the conjunction of rainy peaks of two cycles occurring during a critical portion of the crop season is likely to make a poor harvest. Sir William urges further investigation immediately, before the arrival of 1923, which, being 608 years after the worst famine in the history of western Europe and 123 years after the memorable dearth of 1800, may be one of rain, cold, and bad harvest, and therefore lead to a disastrous economic year for that region in 1924.

Whatever may be the outcome of a further study of this 8-year cycle, the immediate possibilities of the use of our knowledge of the effects of current weather on the growing crops are highly encouraging. What we know about weather and American crops is ably summarized by our chief investigator in this field, Professor J. Warren Smith, in his "Agricultural Meteorology" (New York, 1920; see elsewhere in this *Review*). Those investigations mentioned by Hooker relate mostly to the eastern hemisphere. So far as is known the earliest attempt to estimate the size of a crop by the weather was that of Governor Rawson, of Barbados, who in 1874 published an account of how the sugar crop in hogsheads amounted to 800 times the inches of rainfall of the year preceding the growing season. Gilbert and Lawes, in 1880, found that a temperature higher than average and a prevailing deficiency of rain in winter and spring lead to the highest yield of wheat. Sir Napier Shaw, in 1905, found that the yield of wheat in England was 39.5 bushels per acre minus five-fourths of the previous autumn rainfall in inches. Then Hooker compared wheat yields with temperature and rainfall statistics at all periods of the 18 months before harvest and found that the rainfall between mid-September and early November was the most important. Apparently, just as in eastern Maryland, there is more than enough rainfall for wheat, so that the less

the better. In a region in India where the autumnal rainfall is evidently usually too little for starting wheat, S. M. Jacob found (1910) that the more rainfall in autumn the better the yield. Evidently there must be regions where the rainfall is such that any deviation from the average should give a reduced yield. In Scotland, where A. Watt, in using the ordinary correlation method, could find no connection between spring rainfall and the yield of oats, the usual weather conditions appear to be just right, for in drier England Hooker found that the more spring rain the better the yield of oats.

By using a more or less rough cut-and-try method suitable for showing crop-weather relationship under optimum conditions, Kincer found factors that give a theoretical yield of cotton in Texas showing a correlation coefficient of 0.88 with the actual; and Jacob, with weighted rainfall factors and the subsequent yield of wheat in Jullundur, obtained a coefficient of 0.91. A. Walter has probably carried out the most exhaustive analysis on any single crop. The degree of wetness (monthly rainfall corrected by the ratio of rainy days to total days) at various periods of the year was compared with the yields and a formula obtained. Then the residuals were correlated with temperatures. On the basis of both rainfall and temperature, the yields are indicated quite accurately—so much so that in three years when hurricanes did great damage the difference between the actual yield and the computed yield has been set down as the damage done by the hurricanes, and the theoretical yield has been offered to insurance underwriters as the basis for settling damage claims after a hurricane.

For different regions, on both sides of the optima the most thorough work has been done by A. Wallén, in Sweden, who has charted the correlation coefficients between rainfall and temperature on the one hand and the four cereals (wheat, barley, oats, and rye) on the other, for each of the 26 governments of Sweden in every month of the growing period of the crop during the thirty years 1881–1910. His theoretical yields come very close to the actual. For the same crop the correlations in the north may be the opposite of those in the south, indicating that normal weather in the south may perhaps be too warm and moist for certain phases of the crop's development, whereas the normal weather in the north is too cool and dry. Mathematical treatment leading for each crop to the determination of a curve showing closely the weather control over yield would probably establish general laws applicable in any region.

Hooker deprecates the lack of application of the results already shown to be of such value in the actual forecasting of crops. He points out, however, that there is much more that can be learned about the relation between weather and crops if only the properly qualified persons will attack the large mass of exact data now available for such comparisons. Under Louis Dop, chairman of the Committee on Agricultural Meteorology, the International Institute of Agriculture at Rome is trying to direct the efforts of agricultural meteorologists all over the world. With adequate knowledge of the detailed relationship of the weather elements to the condition of crops we could modify farm practice as regards planting in order to bring a critical stage of the crop at a time most likely to have favorable weather. With forecasts even for a few months in advance, substitute crops could be raised to prevent an imminent crop failure, or at least steps could be taken in advance of a crisis to insure sufficient food supply. Few investigations hold out such promise of valuable pre-harvest safeguards, against a threatened scarcity of food.

CHARLES F. BROOKS

## HUMAN GEOGRAPHY

**Recent Movements of Population.** The political, social, and economic causes with which the great migrations of the past have been associated have never before been at work on such a gigantic scale in the three continents of the Old World at the same time. In this statement is found the moving idea of the author of an able and extremely interesting review entitled "The Migration of the Races" (*The Round Table*, March, 1921, pp. 241–273). The laboring classes have long acquired a mobile character which makes them responsive to the factors affecting migration. They are supplied in their own language with tempting information on distant parts of the world. The Slavs and Italians particularly were accustomed before 1914 to work in mines and on railways in other countries of both Europe and America and return seasonally to their own. In spite of all the causes, associated with the war, that checked immigration into America, there threatened a turn of affairs that would swamp the United States with low-class aliens having no training in the processes of

modern democracy and no appreciation of their own political responsibilities and opportunities. How far can a policy of restricted immigration be carried? Australia proposes to maintain her homogenity even if this means that she is to remain without an adequate population. She fears to lose her internal unity if she admits incompatible elements. Where will this bring the empire? Will an artificial dam prove strong enough to keep out the colored races?

The restlessness of the human race was never so great as today. Some old tyrannies have disappeared, but new ones have sprung up. Hatreds are even stronger than they have been in the past. So intense is the feeling against the restrictions and difficulties of the Old World that not even the present want of means for the journey or the business depression in the new countries to which the emigrant would go are sufficient in themselves to hold back the tide. In 1907 over a million and a quarter immigrants entered the United States, and in that year President Roosevelt appointed a commission to study the subject and directed public attention to the importance of regulating immigration. In 1917 a literacy test was introduced and the admission tax raised. The war of course stopped the flow for a time, and, in the first half of 1919, 4,000 more people left the United States than entered it. In 1920 the tide had set again this way, with 430,000 arrivals, though 288,000 aliens also left the United States in that year.

We thus see the disarrangement of war in still another of its aspects—its effect upon the movement of peoples. Before the war a complex, widely extended economic system had been developed. Its success depended upon a continuance of that security which had brought it into being. Instead of stopping the flow of emigration from Europe and Asia the war tended to hasten it. Agriculture alone cannot absorb a notably large number of people immediately, and it is immediate relief that the would-be immigrant desires. He does not look forward to a future day when business will revive, for he has no capital on which to subsist, and his whole habit of mind is one of direct relation to the problem of food, clothing, and shelter.

From being largely an economic problem, as before the war, the migration of peoples has become now also a political and a social problem. America has built up her railways, her municipal improvements, and her great mills and factories to a very large degree upon imported labor. At the same time that the streams of labor were pouring into the country, her agricultural production was so high that streams of agricultural products were crossing the ocean to industrial Europe. With the continued industrialization of the United States the ratio of export declined, but the manufacturer still clamored for cheap labor. "Improvements in machinery enabled them to do without much intelligence or skill, but cheap labor was indispensable." The native-born American did not wish to engage in the work that thus fell naturally into the hands of the immigrant. Rapidly expanding industrial enterprises took care of the incoming laborer and the second generation of laborers also, the best of whom drifted into other occupations.

By contrast European lands enjoyed a more balanced life, and their populations were more sensitive to stimuli abroad. In the case of the United Kingdom, 20 per cent of the grain and vegetables consumed were imported (for 1913), and 60 per cent of the meat supply. Germany imported 20 per cent of her whole food supply, and France 20 per cent of her grain and vegetables and 60 per cent of her meat. The question of food is thus fundamental to the question of the movement of people in those countries, just as the early Greek colonies in Asia Minor were dependent in part upon the question of food, and just as Japan has sought an outlet for her population in recent years. If life presses upon the individual at home, the modern fast steamship and the lure presented to him by the steamship company and by the country desiring his aid prove too much for him, and he responds quickly and in large numbers. So long as we were confident of our political and social systems, so long as they seemed to work to our advantage regardless of the plight of the incoming laborer, we were little bothered by his influence upon our life, even though we knew that our democratic institutions and ideals meant little to him. It is a commonplace that the war showed that the old bonds between the immigrant and the home country were so strong that we could not count upon a united country. This focused attention upon the character of our alien elements. "Much as our vineyards need laborers we have a lamp to keep alight."

At first our immigrants were chiefly from northern Europe. Latterly they have been from southern and southeastern Europe. The grand total of American immigrants from the British Islands is still larger than from any other country. It stands at almost exactly 25 per cent for the last hundred years, and about half of our entire population is reputed

to be Anglo-Saxon by race. All this is changing, and the change is taking place now. It affects not merely our political forms and social institutions, but it also affects the quality of our people. It would be rash to claim that the last word in democracy will be spoken by Anglo-Saxons. The ultimate goal may be reached by some other race, but the public and its leaders are profoundly convinced that the state of education and the intellectual character of the populations of southern and eastern Europe dilute and weaken our national character, if they do not introduce a positively explosive element into it.

Complementing the paper described above reference may be made to an article, "Les migrations internationales de 1901 à 1920," in the October, 1921, number of the *Bulletin de Statistique générale de la France*. The article referred to consists largely of statistical tables covering the emigration and immigration of the more important countries for the past 20 years. Figures for the United States for 1921 are also available and are specially interesting in regard to the working of the Immigration Act of 1921 which limits the yearly quota from any of the countries of the Eastern Hemisphere to 3 per cent of the total of residents in the United States at the last census who were born in that country. The total number of immigrants admissible for 1921–1922 under this act is 355,825 (not 358,448 as in the article) as compared with 805,228 who entered in the fiscal year 1920–1921, and 1,218,480, the total for 1913–1914. It is probable that the quota for 1921–1922 will not be filled since only 189,421 were admitted from June, 1921, to January 31, 1922. Quotas, however, for the following countries and regions have already been exhausted: Greece, Yugo-Slavia, Poland, Eastern Galicia, Portugal (including the Azores and Madeira), Spain (including the Canary Islands), "other Europe" (including Andorra, Gibraltar, Malta, Memel, Monaco, San Marino, Iceland), Palestine, Syria, Turkey, Smyrna District, "other Asia" (including Mesopotamia, Persia, Rhodes, Cyprus, and territory other than Siberia which is not included in the Asiatic Barred Zone), Africa, Australia, New Zealand, and "Atlantic Islands." Whereas the Polish quota is now exhausted, aliens from the area between the "Curzon Line" near Brest Litovsk and the Treaty of Riga boundary are still admitted, being charged to the quota of Russia. Immigrants from Bessarabia also are charged to Russia rather than to Rumania. It will be noticed that the United States has been obliged to practice a recognition of the new territorial arrangements, including plebiscites, because of the restrictions of the new act. This recognition is not to be regarded as having any political significance, however, or as involving the recognition of new governments, boundaries, or transfers of territory except as have already been formally recognized.

Cuba, the figures for whose average yearly net immigration for the periods of 1905–1913 and 1915–1918 are practically the same (21,000), alone maintained during the war an immigration figure comparable to prewar figures. There the falling-off of European immigration has been met by an influx of Haitians and Jamaicans. During the war and up to 1920, emigration from Australia and the Argentine Republic exceeded immigration into those countries. On the contrary, statistics show that, whereas before the war emigration in Great Britain, Spain, and the Netherlands exceeded immigration, more arrivals than departures were registered from 1915 to 1918 (transportation of troops is not included in the figures). There is some question, however, as to what proportion of these figures represent actual emigration and immigration, since Holland counts as migrants all who change the country of residence for however short a time while Great Britain counts only those who change residence for a year or more.

At present Great Britain and Ireland are rapidly returning to prewar emigration. Italians are going largely to France. Belgians, also, whose emigration figure for 1919 is 38,400, the largest in the history of the country, are going in large numbers to northern France, from which they will eventually return. Large numbers of Belgians, too, came to the United States in 1919, as did also practically the entire emigration from the Netherlands, which in this year was 45,400, exceeding all previous figures.

The article suggests that the steamship companies which made a business of transporting emigrants to the United States will attempt to turn the tide toward South America now that it is evident that immigration into the United States is to be restricted for some time to come. It is to be noted, however, that the countries of western Europe seem likely to fail to fill their quotas for the current fiscal year.

**Spanish Emigration.** Much has been said about the tide of Spanish immigration into America, but definite statistics regarding this movement have seldom been given. The issuance of "La Emigración Española Transoceánica, 1911–1915" (Madrid, 1916), an

official publication of the Higher Council of Emigration (Consejo Superior de Emigración), supplies many important data concerning this matter. According to the official figures there published, the total transoceanic emigration during the five-year period referred to amounted to 602,081, or over 3 per cent of the population of the country. Furthermore, in the above figures is not included the emigration from Spain via foreign ports, which sometimes reaches a fourth part of that officially recorded, nor the emigration to other European countries and North Africa. Adding this we find that the emigration to America was nearly four per cent of the total population. But for the abnormal conditions (economic crisis and the World War) which marked two of the five years (1914 and 1915), the numbers would probably have been far beyond the figures given, since the curve of emigration was rising rapidly during the years 1910–1913.

It is evident that Spain views with a certain amount of concern such an exodus of her inhabitants. But she also recognizes the movement as a natural expansion, which, if properly directed and followed up, offers her an opportunity to recover something of her former influence in America; an influence which was gradually diminishing from the time of the wars of independence until the loss of Cuba and Porto Rico in 1898, when Spain ceased to figure in the affairs of the New World. Under proper direction this new movement of her people to the western hemisphere might mean a re-conquest of Hispanic America, not political but cultural.

The greater part of the emigrants from Spain go to the Argentine. In 1913, for example, of the 151,000 emigrants 101,636 had that country as their destination, while during the entire five-year period those who went to the Argentine numbered 403,164, out of a total emigration of 602,081—a little over 66 per cent. So great, in fact, was the movement of people from Spain to the Argentine in these and preceding years that from 1910 it occupied first place in the current of immigrants into that country, outnumbering even the influx from Italy, which had formerly topped the list.

Cuba was a poor second in the number of Spanish emigrants received during this five-year period, though in 1915 she actually received a larger number than the Argentine. Her total for the five years is given as 135,759, or 22.5 per cent of the total. Next in order came Brazil, though with but 31,516 (or 5 per cent) during the period. Other countries figuring prominently in the list were Uruguay, Mexico, and the United States.

The larger part of the immigration from Spain was from the regions of Galicia, Asturias, and León, in the northwest. The provinces along the Mediterranean (except Castellón, Tarragona, and Gerona) also contributed largely to the tide of emigrants, as did also the north-central provinces in Old Castile, Navarre, and the Vascongadas. In general the coastal provinces, probably because in closer contact with maritime travel, were more largely represented in the emigration than those farther inland. Vigo, Coruña, Barcelona, and Almería were the favorite ports of departure.

Contrary to the usually accepted idea, the writer of the volume on emigration above referred to declares that there does not exist the so-called "swallow" migration between the La Plata region and Spain. There is a constant movement to and fro, a movement which corresponds closely to the harvest seasons in the two countries which, lying on opposite sides of the equator, have their seasons reversed; but this, it is asserted, is not the result of a seasonal migration of the same individuals. The return movement is rather of those who have spent some years in the South American countries and choose the close of the summer season there as the best time to return to their former homes. A like consideration is thought to influence the time of departure from Spain, since the months of September, October, and November show the highest rate of sailings. It would seem doubtful if the earnings obtained by a few months of harvest labor, even with the high wages paid in the La Plata region, would warrant any such seasonal migration of individuals as is often spoken of. However, more detailed statistics than those published by the governments concerned would seem necessary to establish the facts in regard to this seasonal movement.

## GEOGRAPHICAL NEWS

### ASSOCIATION OF AMERICAN GEOGRAPHERS

**Seventeenth Annual Meeting.** The Association of American Geographers met in Washington December 29–31, 1921, for the seventeenth annual meeting. The sessions were held in Hubbard Memorial Building by invitation of the National Geographic Society.

The Presidential Address of Miss Semple, entitled "The Influence of Geographic Conditions upon Ancient Mediterranean Stock Raising," was delivered at the afternoon session of December 30. It gave in outline the results of a thorough study of the subject from classical sources and from observations made during a recent journey in Greece. Miss Semple laid stress upon the continuity of response to environment throughout the long period of from three to two thousand years, dwelling especially on the seasonal movements of peoples engaged in pastoral pursuits and on the peculiar adaptability of different regions for the raising of particular kinds of stock.

Twenty-seven papers were announced on the final program, all of which were given with the exception of "The Barrier Reef of Tagula, New Guinea," by Professor W. M. Davis, which was read by title. "The Problem of Representing the Earth's Surface on a Map" was given by Oscar S. Adams (introduced by William Bowie), and there was a paper on "Some Results of the Recent Cruise of the *Carnegie*, 1919–1921," by L. A. Bauer and J. P. Ault. General physiography was represented by "Certain Features of Arid Region Topography," by N. M. Fenneman; "The Evolution of the Stepped Canyon Profile of Glaciation," by F. E. Matthes; and "Shore Changes Due to Current and Wave Action," by G. T. Rude.

A number of papers discussed aspects of the physical geography of the United States: "A Proposed Alteration of the Physiographic Map of the United States," by N. M. Fenneman; "The Trend of Land Utilization in the United States," by O. E. Baker; "A Soil Map of the United States" and "The Soil Geography of the Northern Great Plains," by C. F. Marbut; "Topographic Types about Nashville," by A. E. Parkins. Dealing with the human side were "Some Regions in the United States with Stationary Population," by R. M. Harper; "City Growth and City Advertising," by Robert M. Brown. Human utilization of regions was the basis of "A Regional Economic Map of North America," by J. Russell Smith.

H. N. Whitford spoke on "The Climatic, Genetic, and Economic Relations of the Forests of the Torrid and Temperate Zones," and C. S. Scofield on "Limitations of Irrigated Agriculture."

Papers in the Latin American field were given by O. F. Cook, "Peru as a Center of Domestication," and E. F. Bransom (introduced by H. H. Barrows), "Geography of Eastern Costa Rica." Regional papers outside of the Americas were "Geographic Setting of Chengtu, China," by George D. Hubbard, and "Urundi," by H. L. Shantz.

Work of the National Geographic Society was described by Gilbert H. Grosvenor, "The National Geographic Magazine," and N. M. Judd (by invitation), "The Pueblo Bonito Expedition of the National Geographic Society." Two papers dealt with educational geography: "Twenty-Five Years' Growth in Collegiate Geography" (in the United States), by George J. Miller, and "Some Observations on the Status of Geography in Western and Central Europe," by W. L. G. Joerg. J. Paul Goode spoke on "The American Need for Authority in Fixing the Form of Foreign Geographic Names." A survey of the publications of the Association was made by Richard E. Dodge in "A Decade of the Annals."

Members of the Association were afforded an excellent opportunity of learning something of the geographic work in the Federal Service. This was the theme of the Round Table Conference held at the evening session of December 29 at which the discussion was led by A. H. Brooks and C. F. Marbut. Work in the various departments was described as follows: State Department by Colonel Martin, Hydrographic Office by G. W. Littlehales, Geological Survey by P. S. Smith, Bureau of Plant Industry by H. L. Shantz, Bureau of Farm Management by O. E. Baker, Bureau of Soils by C. F. Marbut, Bureau of Fisheries by H. F. Moore. At another session an interesting series of papers (requested) dealing with geography and trade was contributed by W. S. Culbertson of the U. S. Tariff Commission ("Colonial Tariff Policies"), Julius Klein, of the U. S. Department of Commerce ("Geography in the Bureau of Foreign and Domestic Commerce"), and E. S. Gregg, of the U. S. Department of Commerce ("Influence of Geographic Factors on Ocean Shipping"). One of the most interesting features of the meeting was the social evening held at the Geological Survey Building at which was given an exhibition of geographic work and a demonstration of map methods of the Survey.

**Joint Meeting of the Association of American Geographers and the American Geographical Society.** At the building of the Society on April 28 and 29, there will be held the annual joint meeting of the Association of American Geographers with this Society.

A preliminary program is in preparation and will be mailed to all out-of-town Fellows upon request. The final program will be distributed a week before the meeting and will also be printed in full, with a brief synopsis of each paper, in the July number of the *Geographical Review*. This brief preliminary announcement is made in order that anyone interested may have the opportunity of attending the meeting.

## Obituary

Julius von Hann. It is nearly half a century ago that Julius von Hann began to take his place as the universally acknowledged leader of meteorological science, and for many years previous to his death he stood out head and shoulders above his fellow workers. He grew up with and himself was, as it were, a large part of the rapid modern development of meteorological science. He was able, through his intense application and industry, and because of his great intellectual powers, not only himself to contribute largely to the advance of his science but also to keep closely in touch with all the work which was being done by investigators and writers everywhere. For years his many contributions to the *Meteorologische Zeitschrift*, often modestly signed J. H., were never-failing evidence of his truly extraordinary grasp of his subject and of the universal range of his reading. He was, as fully as any one human being can be, a living encyclopedia of his chosen science. And this is in no sense to be taken as suggesting that his mind was merely a storehouse of dry, hard facts. He was very human. He saw the many and varied relations of meteorology and climatology to human life and activities, and he was always on the lookout for opportunity to emphasize these relations. His writings were always clear, vivid, and interesting. His "Handbuch der Klimatologie," for example, which inevitably has to deal largely with "dry" statistical details, is enlivened throughout by carefully selected, vivid, first-hand descriptions of weather types and of human or botanical responses to the climatic environment.

His fellow workers who remain are dynamic or physical meteorologists, or climatologists, or are specializing in this or that subdivision of their science. This is a natural and inevitable situation at the present stage of our knowledge of the atmosphere. It cannot well be otherwise. But it leaves a great gap which no one man can ever again fill, because meteorology has now grown to such an extent that specialization is the rule, and no single mind will ever again master all of its details. Hann's "Lehrbuch der Meteorologie" is the one absolutely indispensable textbook in that science. Upon his "Handbuch der Klimatologie" all studies of climatology must, for years to come, be based. This extraordinary grasp of the whole wide range of his science he maintained practically till the day of his death.

Somehow, when a man like this passes away, a bare statement of the essential facts of his life and a list of his contributions to science seems unnecessary and futile. Yet there is something singularly significant in the fact that this man, living a very simple life, with very few changes of residence, extended his interests and his reading to all parts of the world. He knew the geographical and climatological conditions of almost every corner of the globe as intimately as if he had himself lived there. Hann—for thus, and not as von Hann, he will oftenest be recalled—began life as a school-teacher. At the age of twenty-nine he entered the Central-Anstalt für Meteorologie in Vienna. From 1874 to 1897 he was its Director, an office from which he retired at the age of fifty-eight. For many years he was also Professor of Cosmical Physics at the University of Vienna. His work for meteorology did not cease when he ceased to be Director. He soon went to Graz, where, in the Physikalisches Institut, he wrote his "Lehrbuch der Meteorologie," whose three editions bear the dates 1901, 1906, 1915. The "Handbuch der Klimatologie" he wrote while in Vienna. The three editions of this book bear the dates 1883, 1897, 1908–1911. These two books are Hann's monumental publications. It is almost literally true that no student of meteorological science can do a day's work without referring to them. Throughout his long editorship and joint editorship of the *Meteorologische Zeitschrift* (1866–1920) he steadily contributed to the pages of that journal a series of articles and notes which are invaluable, for in these he revised, summarized, commented upon, and put into permanent form a vast body of meteorological and climatological material.

Hann died in Vienna, October 1, 1921, in his eighty-third year. No more fitting tribute could possibly be written of him than that contained in the notice of his death sent out by his former colleagues in Vienna. "Ein Leben ununterbrochener Geistesarbeit und reinster Forschung im Dienste der Wissenschaft ist abgeschlossen. Aber ungezählte Fäder führen von Hann's Werken in alle Länder der Erde und wirken in seinem Sinne fort."

R. DeC. Ward

SIR ERNEST SHACKLETON. With the death of Sir Ernest Shackleton Britain loses one of the most brilliant explorers of modern days. Shackleton began his career of Antarctic exploration as a member of Scott's 1901–1904 expedition in the *Discovery*. Characteristically enough he was one of the party of three that achieved the "farthest south" of that date, reaching to within 463 miles of the pole. In 1907 Shackleton returned to the Antarctic with his own ship, the *Nimrod*, on an expedition notable for its employment of new methods and equipment and for its striking results. Like the succeeding expeditions, it was a purely private enterprise. Of the results it is enough to say that Mt. Erebus was climbed, the Magnetic Pole was discovered, and a journey was made via the great Beardmore glacier to within 100 miles of the pole. Among polar expeditions it stands out as one "well conceived, well planned, and well carried out," as Edwin Swift Balch says in his review of "The Heart of the Antarctic" (*Bull. Amer. Geogr. Soc.*, Vol. 42, 1910, pp. 9–21). Among the many honors bestowed on its author was the Cullum Geographical Medal of the American Geographical Society.

Immediately on his return from the Antarctic Shackleton gave his interest and support to the proposed Australasian Antarctic Expedition, the command of which he handed over to Mr. (later Sir) Douglas Mawson. He himself worked out a project for crossing the Antarctic continent from the Weddell Sea to the Ross Sea. The *Aurora*, which had been engaged in the Australasian expedition, was detailed to proceed to Ross Sea with a party to lay a chain of depots to Beardmore glacier for the transcontinental journey. This was accomplished; but meanwhile the ship broke away, leaving this section of the expedition stranded in winter quarters, whence they were ultimately rescued by the *Aurora*, with Shackleton on board. The *Endurance* carrying the Weddell Sea party was still more unfortunate. After cruising along Coats' Land she was caught in the ice on January 15, 1915, and drifted northward until October 27, when she was crushed. Shackleton and his party continued drifting northward on the ice floe until April 12, 1916, when they made for Elephant Island. The story of the leader's bold journey in a small open boat to South Georgia (750 miles) and across the mountainous, glacier-clad island on foot to the whaling station and of his repeatedly attempted and ultimately successful rescue of the marooned men left behind under Frank Wild is well known and justly acclaimed as one of the greatest epics of polar exploration (see *Geogr. Rev.*, Vol. 2, 1916, pp. 54–57; 231–232, and Vol. 3, 1917, pp. 245–246; 397). Shackleton's own story of the expedition is told in "South" (1920).

On this return from polar regions Shackleton served in the army—as officer in charge of supplies for the British forces in the White Sea and northern Russia—until conclusion of the war released his energies for further polar work. He at first planned an expedition into Arctic waters, to the Beaufort Sea, but subsequently he decided to return to the Antarctic to carry out investigations in the practically unknown Enderby Quadrant and various little-known sub-Antarctic islands. The *Quest* left England September 24, 1921, and after a stormy voyage entailing trying delays she had only reached South Georgia when on January 5 her commander died suddenly at the age of 48. In accordance with what would undoubtedly have been his wishes the expedition will continue under the leadership of Wild, while Shackleton has been buried in that remote island on the threshold of the Antarctic.

Shackleton's personality was not less interesting than his exploits. To his commanding personality, his courageous and indomitable spirit, and certain quality of "instinctive judgment" that together made for leadership in a supreme degree tribute is paid by Hugh Robert Mill in a recent number of *Nature* (February 2, 1922), and a splendid portrait, "Sir Ernest Shackleton: A Study in Personality," is sketched by Charles Sarolea in the March number of the *Contemporary Review*.

## Arctic America as a Pioneer Belt

Vilhjalmur Stefansson. **The Friendly Arctic: The Story of Five Years in Polar Regions.** xxxi and 784 pp.; maps, ills., index. The Macmillan Co., New York, 1921. $6.50. 9 x 6 inches.

"There may no longer be a Far West, but there is a Far North with the same nebulous and glamorous future within which shall rise stately cities and empires of productivity." In this sentence from page 670 of "The Friendly Arctic" Vilhjalmur Stefansson summarizes his creed. While others prefer to live farther south and in a warmer climate, a few, including Stefansson, prefer the Arctic. On the same page, one learns that "Mr. Seymour lives in the Arctic rather than anywhere else;" Storkerson prefers it also, and the list is lengthening yearly. If Daniel Boone were alive, he would probably be a denizen of the Arctic. It is the great undeveloped pioneer land of the world. There are vast prairies of grass for the support of reindeer herds and musk oxen, or ovibos, as Stefansson prefers to call them. It is commonly thought that the only useful vegetation of the snow-free surfaces of the Arctic is "mosses and lichens," but Stefansson frequently emphasizes the presence of grass—unused but useful, short but nutritious, snow-covered for a part of the year, but the snow cover is thin.

We are told that the man who goes to the Arctic must use his wits, and we judge from the adventures of Stefansson that he must use his wits constantly and that they must be of exceptional quality if he is to succeed. Thomsen lost his life in a blizzard, apparently, though he stepped away from his snow house only a yard or two. After conferring about the course of the *Karluk*, Stefansson and Bartlett decided to stand off the land at a greater distance at a critical point on the north coast of Alaska. Stefansson found out later that this was a very serious mistake of judgment. Had they stood closer in, the vessel might not have been lost. But the best judgment at which these two experienced Arctic explorers could arrive is acknowledged to have been an error. The results we already know: the *Karluk* drifted westward in the grip of the sea ice and was finally lost; several members of the scientific staff and crew died of nephritis; others who went out to explore the ice never returned; one committed suicide. Out of a total personnel of more than seventy, as listed on pages 758–760, sixteen lost their lives on what is said to be the best equipped polar expedition that was ever organized.

We have referred to Thomsen. His companion was Bernard. After Thomsen's death Bernard advanced farther along the coast of Banks Land. He had access to abundant stores of food separated by moderate distances. All trace of him was lost. It is thought probable that he perished in trying to go forward over the sea ice.

The mistakes of judgment that involve the loss of a number of lives, accidents that result in death, suicides—if one were to become absorbed in these evidences of the *un*friendliness of the Arctic one might be led to frame an old-fashioned and convincing story of Arctic hardships and of the impossibility of future development of these now all but empty lands.

Here is where Stefansson shows qualities that we believe no other polar explorer has possessed. He refuses to be stampeded by the dangerous and the romantic. He is not out to make himself a hero. He is studying a problem, and he reports on it. In his way of thinking the Arctic has undeveloped resources, and the resources of the earth are being strained to supply the ever-growing needs of a mounting population. Among the dwindling resources of the world are grasslands. The rise in the price of meat will continue. Nothing can stop it. It is an established economic law. It surely follows that pasture lands of wide extent and that may be grazed by an animal like the reindeer, perfectly adapted to the kind of pasture that the Arctic affords, will not long remain in a state of disuse. Whatever the inconveniences, whatever the dangers, the increasing cost of meat will impel men to exploit the prairies of the North.

It would be a mistake to suppose, however, that the book deals only with the material aspects of the future of the Arctic. To a thoughtful person it is the most fascinating book of polar

exploration yet written in any language—for the story it tells, the breadth of its philosophy, and the style in which it is written. Everything is set forth with simplicity and directness. No one else has written on the Arctic with such charm and lucidity, and surely no one else has so frankly swept aside the romantic phases of his many adventures and coldly analyzed them from the standpoint of ideal achievement. It seems as if every experience was played upon by an ever active mind, intent on getting the inner meaning out of Arctic life and not in carrying home brightly painted pictures of strange scenes and people. It deserves to be ranked among the great classics, like Livingstone's "Travels in Africa," to which it bears many striking resemblances, and Doughty's "Travels in Arabia Deserta," and a few others.

Our first view of a country is always the romantic one. Over the edge of the horizon is something strange. The world wants to hear about it. The audience carries the speaker off his feet. Ultimately the strange becomes better known and must be interpreted, not merely described. It is, therefore, the natural time for such a book on the Arctic to appear. Stefansson will stand for all time—not merely because of "The Friendly Arctic," but also for "My Life with the Eskimo"—as the great interpreter of the North.

Stefansson does not hesitate to blame others for their blunders and failures, but he is no more sparing with himself. It was almost inevitable that there should arise a clamor of criticism regarding his management of the expedition. Obviously it was not closely organized within itself. The several parts were to do work on a semi-independent basis. A wide field had been laid out. Each leader of a party was assumed to be a man who could meet a great emergency. In a too closely organized and minutely directed expedition difficulties arise because specialists are not given sufficient liberty of action. Stefansson chose a wiser and a broader course. He sought to pick big men and put them upon their own responsibility. When difficulties arose he met them in a spirit of concession. Only a broad-minded leader could have taken the course which he took in the face of a threatened mutiny of part of his staff. And later on in his book he gives generous praise to the scientific results of those who had earlier sought to defeat his purposes. Of his courage or of special strength in facing physical obstacles and dangers he makes light at every turn. And while it is true that one recognizes a capacity for physical endurance, the thing that stands out is his power of philosophical thought.

The scientific results of the expedition are to appear in a series of monographs, and an appendix to the book tells of the work of the southern section of the expedition. It is thought probable that the complete scientific results will involve years of further research work and the publication of more than twenty, and possibly thirty, volumes. Several hundred miles of coast line were surveyed, and positions and outlines were corrected; new lands were discovered beyond the northwestern border of the Canadian Arctic Archipelago as previously delineated upon the charts; a scientific study was carried through of the vast copper-bearing rocks on the Arctic fringe of the Canadian mainland; ethnological collections and studies of wide scope and importance were conducted upon Eskimo groups that are still measurably free from white influences. Soundings and meteorological observations were made which extend our knowledge of the ocean floor; the regimen of the currents and the sea ice was studied, and climatic data were assembled. Stefansson himself thinks that it is not the formal scientific results of the expedition that are the most valuable part of it, "but rather the general change in the trend of the world's thought which should follow from a broad consideration of what was done and of how it was all done." "It is not only ignorance but also romance that retreats before the advance of knowledge" (p. 687).

The most challenging thing about the book is its title. A question insists on repeating itself, no matter how coldly analytical one's mood: Is the Arctic really friendly? We have referred to the loss of life on this splendidly equipped expedition. Now there is an occasional suicide in the Temperate Zone. Naturally it may occur in the Arctic. Peary considered George Borup the best man in his party as a pioneer in trail breaking. Though only a boy in years, Borup was a man in physical strength and resourcefulness. With a single Eskimo he made a long hunting journey for musk oxen by moonlight and survived every peril of the North. He lost his life by falling overboard from a motor boat in Long Island Sound! Death is commonly less of a mystery than an accident. If Thomsen lost his life in a blizzard within a few feet of his hut, and he an experienced polar traveler, so do the annals of the pioneer record loss of life from blizzards on the prairies of North Dakota, Kansas, and Nebraska. A freeze following a sudden thaw may cover the ground with ice and cause great loss of life among reindeer that may come to thrive on the Arctic prairies some time in the future, but frosts now and then also kill many of the orange groves of

Florida and southern California. Grasshoppers may devour the crops in Guatemala and the Argentine, and a storm may scatter and destroy a fishing fleet in the North Sea.

What are the distinctive risks of the Arctic? For one thing, in a pioneer region the risk of death is greater than in organized and developed communities. If you break a leg in the Arctic or get typhoid fever there, you cannot call the doctor by telephone or expect him to arrive within the next hour. Not only the pioneer of the Middle West and the Far West but also his wife and children took risks, and many suffered death because of pioneer conditions pure and simple. To that extent the pioneer belt was not friendly. So the prairies of the Far North are to be taken as part of a pioneer zone, where loss of life will be relatively heavy and where friendliness is but relative. It is also true that many people lose their lives because they have not the wit to meet an emergency, but if they truly have not the wit they cannot be blamed for losing their lives. No matter what the sources of a man's thought about it may be, whether in cheap story books or bad textbooks or his own instincts, if he thinks the Arctic is terrible, terrible it is to him, and he can hardly be blamed for it if it drive him to insanity or suicide or only keep him in organized communities where there are kin and so-called comforts and a sense of security. The things that matter in the tendencies of a people are not only the objective facts of their environment but also what they think about the facts. Group behavior is not a good basis for proving that man is a rational animal. The tide will be long in turning to the northern prairies. The Arctic will not be called friendly by the majority of thinking people who read about it even in Stefansson's pages; it is truer to say that the Arctic has been friendly to Stefansson.

## A Symposium on Political Problems of Mexico, Central America, and the Islands of the Caribbean

G. H. Blakeslee, edit. **Mexico and the Caribbean.** Clark University Addresses. x and 363 pp. G. E. Stechert & Co., New York, 1920. 9 x 6 inches.

One of the most practical of the attempts that have been made in the last twenty years to obtain a frank exchange of views between thoughtful people in Hispanic America and the United States is this volume of addresses delivered at Clark University in 1920. The organization of the matter, under the editorship of Professor Blakeslee, is most happy. Four introductory chapters deal with fundamental factors, that is capacity for self-government on the part of Mexicans, the character of the Mexican people, the Indian element, and the question of health. A second section takes up special problems, such as oil, railroads, labor, and reconstruction. A third includes a study of recent conditions, the present revolution, the relation of the United States to Latin America, etc.; and a fourth deals with Central America and the islands of the Caribbean.

The best papers in the book are the first and the last. The Honorable T. Esquivel Obregón, Minister of Finance in the Cabinet of Mexico in 1913 and Lecturer on International Law at Columbia University, has a brief introductory paper setting forth six fundamental facts to support a conclusion regarding the capacity for self-government among Mexicans. For our people it is one of the ablest and most constructive political documents in the English language, because it is entirely frank and it springs from a wide knowledge of human nature as well as from a knowledge of the specific problems of the Mexican people. The last address deals with the subject of Porto Rico. While maintaining an attitude of sympathy with the overlordship of the United States, the author, Pedro Capó Rodríguez, Spanish editor of the *American Journal of International Law*, handles the problem of Porto Rican relations in a thoroughly statesmanlike manner.

These and other thoughtful papers in the volume emphasize repeatedly what might be called the first fundamental fact in a study of Hispanic America—that the point of view of the institutions and the spirit of our people and those of Hispanic America are fundamentally dissimilar. The Latin American people look to the older cultures of Europe to satisfy their taste and manners, their philosophy and their ideals. Contributing powerfully to the fostering of this relationship is the better shipping service to England and France from South American ports, the closer similarity of language, and the European view of the social and political problems of the day. There is a racial difference between us and the people of Hispanic America that is even more nearly fundamental. Our ethical standards are unlike; and, though our political forms are superficially similar, there is

the widest divergence of view in the practical application of liberal constitutions to the present needs of the people. Back of this divergence also is an age-old and basic dissimilarity in social and political ideals.

In recent years we have further complicated the problem by advance into the Caribbean, and one after the other of the papers in this volume emphasizes the difficulties and downright antagonisms that have resulted from such an advance. Our people have not gone into Hispanic America in large numbers to settle and develop the country. They have gone in as exploiters for business purposes, and political control under these conditions cannot be anything else than an artificial thing. Our geographical proximity to the Caribbean and to Mexico and Central America has obliged us to establish political relations that are not in harmony with the liberal tendencies of our government and of our time. Yet it has seemed as if we could not escape the imposition of strange political forms and ideals upon the adjacent republics because of the responsibilities that inevitably fall upon us in consequence of our interpretation of the Monroe Doctrine. With an eye single to business and to strategic control we pass over the finer elements in Hispanic American life. We do not cultivate an acquaintance with the lawyers and authors of Hispanic America. We do not seek them out and attempt to understand their point of view. Our business representatives expose but one aspect of American life, and it is this aspect which fills the entire horizon of many Hispanic Americans who try to understand us. The consequence is that our entire culture appears materialistic and to a high degree selfish and even hostile.

The sum of these influences is set forth clearly and unmistakably in one after the other of the addresses in this volume. The geographical and territorial facts recited merely emphasize this conclusion. The book contains little of suggestion as to the settlement of these problems. It merely presents them. It must be read by every geographer who wishes to understand the problems of trade, of human distributions, the development of resources, and the political geography of Hispanic America. For statesmen it is the beginning point in any sound consideration of a problem in international relations that forms one of the two or three major problems confronting the United States today.

## Economics of Argentine Agricultural Exports

E. W. Schmidt. **Die agrarische Exportwirtschaft Argentiniens.** xv and 296 pp. (Probleme der Weltwirtschaft, No. 33.) Gustav Fischer, Jena, 1920. 9½ x 6½ inches.

If political science includes the economic life of nations Ernst Wilhelm Schmidt, Doctor of Political Science, reflects the greatest credit on his training by this book. It is admirable—a great credit to German science and scholarship.

The "Economics of Argentine Agricultural Exports" deals with the grain and cattle products of the Argentine Republic. It is clearly written and illustrates its points by means of 82 little tables which are wonderfully illuminating. The list of them does a good deal to take the place of the missing index. The treatment is strictly scientific, a statement of relations and elaboration and demonstration, unenlivened by pictures or expressions of feeling. Reference to the author's year of travel in the Argentine is limited to the preface.

For Schmidt the Argentine Republic is restricted to the "main agricultural zone," contained in the provinces Buenos Aires, Santa Fé, Córdoba, Entre Ríos, and the Territory of the Pampa Central. This is the geographic region known as the Pampa. Its area is about a quarter that of the Republic. It is a great treeless, pebbleless plain of loess, well supplied with humus, with a mild, temperate climate and rains that usually suffice for crops, though recurrent droughts are a great drawback. It is covered with natural grasses that are "tender" (*pasto tierno*) in the southeast—Buenos Aires, southern Santa Fé, and Entre Ríos—and tougher, less nutritious (*pasto fuerte*) in the north, southwest, and west. On these plains the Spaniards released Andalusian cattle brought in the sixteenth century from Spain by way of Peru. They multiplied rapidly, a tough, bony breed, equally resistant to weather, thirst, hunger, and the teeth of the consumer. But the hides made good leather and the meat, lacking fat, was most suitable to make jerked beef. The hides were the only commodity the early Argentines had to exchange for European wares with the smuggling English and Portuguese at a time when Spanish colonial policy made trade at Buenos Aires illegal. The founding of the Viceroyalty of the Rio de la Plata and permission to trade with Spain and other colonies gave the trade in hides a great impetus, still more independence (1810), and free intercourse with all nations. By 1820 there had grown up

a large business in supplying jerked beef for Cuba and Brazil. It was cheap, nutritious food for slaves, as in the Argentine it was a cheap, abundant food, consumed in enormous quantities by Creole Argentines whose lower classes hardly knew any other nourishment.

With the introduction of chilling and freezing plants in the middle of the nineteenth century came the importation of English stock to produce a fatter, juicier beef, better adapted to the English taste. With improved stock came the need of better fodder, and alfalfa began to replace even the famous *pasto tierno* of the southeastern pampas. The creole cattle of the *pasto fuerte* zone still maintain themselves as hide producers and in the north, being immune to a cattle malaria that destroys improved breeds there, still supply jerked beef through establishments in Entre Ríos and send stock to the *saladeros* of Uruguay and southern Brazil, though in diminishing quantities. Similarly creole cattle are driven over the Andes to Chile from Mendoza and San Juan—an old, old business with a crop that traveled, self-propelled, to market.

Until nearly 1890 the grain production of the country did not satisfy home needs, and wheat and flour had to be drawn from Chile where agriculture had an earlier start. The grain raisers in the Argentine were the new immigrants of the last 50 years. The gaucho of the Pampa was by birth and instinct a horse and cattle man, entirely averse to any form of agricultural labor. Immigration and, after it, the railways to carry agricultural products to the seaboard were the two developments needed to spread wheat- and corn-raising over the whole agricultural region. At length the farm exports have become equal to and in many years greater in value than the cattle products. Between them these products of the soil make up four-fifths of the billion dollars' worth of Argentine exports. Argentine agriculture is always extensive and mostly ignorant, like the European immigrants who practice it. Too rarely the farmer owns the land he tills, such being the case on about a third of the farms. These farms are probably the smallest ones, so that they do not represent a third or anything like a third of Argentine agriculture. Agriculture suffers from the dominance of exportation and large landownership. Local consumption of farm products is very small, quite the opposite of the case with grazing, for it is believed that three times as much meat is consumed in the country as is exported. The southern hemisphere situation, having summer when the north has winter, combines with the difficulty colonists experience in acquiring small plats of land, to discourage immigration while encouraging seasonal visits of harvest laborers from Italy and Spain, who return north with the sun and have no permanent stake in the country. Control by export needs and large ownership combine to limit farm operations to a single crop and make well-nigh impossible the crop diversification and home improvement that the national department of agriculture advocates so zealously. If the creole working class takes naturally to horses and cattle, so does the creole landowner too. He has no taste for agricultural undertakings. However, he has introduced English "pedigreed" cattle and must put part of his *estancia* into alfalfa to feed them. This he turns over to the immigrant colonist on a moderate rental with a contract to plant wheat two or three years and put in alfalfa seed, supplied by the owner, with the third-year crop, the land then reverting to the original owner, who can return his cattle to it for another ten or fifteen years. Thus a considerable expansion of Argentine grain exportation has accompanied the introduction of fine cattle into the country without permanent increase of farming land but with the addition of seven and a half million hectares of alfalfa land in twenty years—an interesting play between the two chief occupations and interests of the inhabitants of the republic.

The future of the country demands more people. If it were possible for them to acquire land suitable for agriculture which is now in private hands, yielding a poor return by sustaining poor cattle on natural grasses, there would be room for a large number of intelligent immigrants. They could have comfortable and attractive homes on farms diversified with fruit, vegetables, grain, and cattle, and they could make Argentine fields produce larger quantities of meat and grain for export than any other region. The United States has ceased to have a surplus of either grain or meat, having a great industrial population to feed at home. Such a population can never grow up in the Argentine Republic on account of her lack of fuel. But Argentine lands have been alienated to influential persons in large blocks till the government has practically none in the best agricultural regions. Will the republic obtain immigrants of the required intelligence? Will the needed lands be taken from private owners and given to the immigrants? Probably not, but some progress in both respects is likely to be made.

MARK JEFFERSON

## Mapping Agricultural Production in South America

Lila Thompson. **Corn, Wheat, Sugar, Rice, and Cotton in South America.** Maps, ills. *Bull. Pan Amer. Union*, Vol. 52, 1921, pp. 339–363.

Lila Thompson. **Distribution of Live Stock in South America.** Maps, ills. *Bull. Pan Amer. Union*, Vol. 53, 1921, pp. 109–124.

The line of research which made Finch and Baker's "Geography of the World's Agriculture" so valuable a contribution to economic geography has been followed in these useful papers. The writer, research assistant in agricultural geography in the United States Department of Agriculture, has compiled available statistics showing the importance of the crops named and of the live stock (cattle, sheep, goats, swine) in each of the South American countries and has mapped their distribution.

These papers supplement the larger work referred to in that the production of many South American countries was proportionately too small to find a place in a summary of the regions most important in the world's agriculture. Production rather than acreage is made the basis of representation of the crops, because statistics of acreage devoted to individual crops are not published by most of the South American countries.

The production maps (scale 1 : 50,000,000) that accompany the articles, when compared with maps showing relief, rainfall, temperature, and the distribution of population, afford an excellent basis for study of various geographic factors that have affected human occupation in the several regions. Some of these factors are brought out in the papers: others will be readily apparent to the student of South American geography.

## An Agricultural Atlas of Wales

J. Pryse Howell. **An Agricultural Atlas of Wales.** [6 and] 23 pp.; maps. Prepared for the Inst. for Research in Agricultural Economics, Univ. of Oxford. Ordnance Survey, Southampton, 1921. 5 s. 10½ x 15 inches.

This publication consists of 18 maps showing, by the dot system, the geographic distribution of the more important crops and kinds of live stock in Wales, by parishes, according to statistics collected by the Ministry of Agriculture and Fisheries in 1918. In addition, 5 dot maps show the distribution of market towns, of mountain and heath land, of permanent grassland, of arable land, and of bare fallow. An envelope at the back, furthermore, contains three colored maps showing the geology, the topography, and the average annual rainfall. The crop, livestock, and other distribution maps are printed on translucent oiled paper; and the colored maps, being loose, can be inserted beneath the dot maps in order to facilitate comparison between distribution of the crops and the physical conditions shown on these three maps.

The relationship between the rainfall and the distribution of wheat is clearly marked, most of the wheat being grown in those areas having less than 40 inches average annual precipitation, and practically none in areas having over 60 inches. This absence of wheat from the regions of heavy rainfall may also be due, in part, to the higher elevation and presumably cooler temperatures of these upland areas and to the rougher topography. However, as wheat in nearly all parts of the world is of greatest importance in regions having 15 to 35 inches of rainfall, it seems very likely that in Wales, also, the amount of precipitation is the primary factor in determining the distribution of this crop. Barley, on the other hand, shows the densest distribution in regions having 40 to 60 inches of rainfall, while a considerable acreage of oats is indicated for areas having over 80 inches of rainfall and appears to be densest in the 40 to 60 inch zone. Beans are practically confined to the regions having less than 30 inches of rainfall, while potatoes, turnips, and mangolds show no marked preference with reference to amount of annual rainfall.

The correlation of crop distribution with topography and altitude is also evident, the crops being grown in the valleys and on the lower slopes of the mountains, while the higher slopes are largely covered with heath and an appreciable acreage of permanent grass. The comparison of the map of arable land with the relief map is especially effective.

The inclusion of the geological map appears to be due to tradition rather than any correlation between the geological formations and the distribution of the crops. Indeed, the author in the introduction says, "It will be observed that except in the mountainous

areas the geological formation does not determine the distribution nor the density of either crops or livestock."

It is unfortunate that Great Britain has not awakened as yet to the value of a soil survey in directing the development of agriculture, as well as in affording an explanation of the geographic distribution of crops and systems of farming. Undoubtedly, if a soil map had been available it would have been substituted for this practically useless geological map.

The unique feature of this publication consists in printing the dot maps on oiled paper so as to permit comparison with the physical maps. This detracts somewhat from the visibility of the dot maps, but greatly enhances their value for study purposes. If it had been possible to print the physical maps instead of the dot maps on oiled paper, comparison would have been possible without this diminution of visibility.

The Atlas is of practically the same size and shape as the "Geography of the World's Agriculture," published by the U. S. Department of Agriculture; but why it should have been made of this shape is not so clear, as, unlike the United States, Wales is longer than it is broad, and even with the insert table not more than two-thirds of the page is occupied. These insert tables, showing for each county the acres of arable land and the acreage of the particular crop, also the percentage which this acreage bears to the arable land, are a valuable feature. Also deserving of special note is the fact that the dots are distributed by parishes, which roughly correspond in area with townships in the United States. Thus a more exact and detailed distribution is shown than is possible in the case of the United States, where statistics are tabulated by counties.

The introduction to this Atlas indicates that a corresponding publication for England may be available at an early date. This would constitute an even more notable addition to our knowledge of the agricultural geography of foreign countries; and if the work is carried out with the same detail and care that is shown in the Atlas of Wales, it will be of great value to students of agriculture and geography everywhere. It is hoped that this larger atlas may be published soon. If the author would comment on the physical and economic causes of the distribution of the crops and live stock more fully than has been done in the Atlas of Wales, it would materially enhance the value of the publication to those students in foreign countries particularly who have not had the opportunity to travel in England and, consequently, are not familiar with local conditions.

O. E. BAKER

## MAN AND HIS PAST

M. C. BURKITT. **Prehistory: A Study of Early Cultures in Europe and the Mediterranean Basin.** With a short preface by l'Abbé H. Breuil. xix and 438 pp.; ills., bibliogr., index. The University Press, Cambridge, 1921. 9½ x 7 inches.

This new textbook on the prehistoric period appears at a most opportune time, just when interest in research is reviving after the long interruption occasioned by the late war. It will appeal primarily, of course, to workers in the archeological field. But it also contains much that will be of value to students of the history of art; while all those who feel the fascination of the story of primitive man, or who wish to keep in touch with the progress of discovery, will find "Prehistory" abundantly worth the reading.

It may be said by way of premise that Professor Burkitt's choice of a title for his book does injustice to a really excellent piece of work, simply because it awakens too great expectations. As a perusal of the volume will show, comparatively little attention is paid to any part of the Mediterranean Basin, or of Europe either, save southern France and northeastern Spain. Other areas are mentioned only rarely, and then as a rule merely for purposes of comparison or contrast. Further, instead of presenting us with the connected story of man's physical and cultural development during the whole of the prehistoric period, as the title would lead us to expect, the author confines himself almost wholly to the implements and the art of the Old Stone Age. Within these limits of time and space and subject matter, however, the book merits no little praise.

The opening chapter gives a brief but good account of the distribution of early man and the conditions under which he lived; the outline of the development of the science of prehistoric archeology (pp. 10–15) with which it terminates should be particularly useful for purposes of reference. A timely caution is given (p. 2) against confusing cultural and time ages—something that might be obviated if writers would speak of culture stages instead of ages. But Professor Burkitt is hardly justified in characterizing (p. 3) the absence

of a Bronze Age as "abnormal." If he had in mind the particular area indicated in the subtitle of his book he would be perfectly right; but he happens here to be speaking of Fiji. A Bronze Age is by no means a phenomenon of universal or even of general occurrence. It appeared only in a definite area of the Old World, as one of the elements of a particular culture complex. In point of fact by far the greater part of the world has gone directly from the Stone Age into that of Iron.

The second and third chapters deal with the geology of the early human period, while the fourth gives an interesting account of flint and its properties and the various types of implements made from that material. The descriptive classification of Paleolithic artifacts on pages 67–78 is full and explicit. The same mastery of the subject appears in the following eight chapters, treating of the successive culture divisions of the Old Stone Age. These are among the best in the book. The author's suggestion of an African origin for the Chellean culture (p. 86) is of particular interest in the light of the recent discovery in South Africa of a skull of Neanderthaloid type and of implements resembling those found at Chelles-sur-Marne.

Chapters XIII and XIV, dealing with the Neolithic and Bronze Ages and the physical characters of prehistoric man respectively, are brief and would be altogether inadequate were the book really, as its title suggests, a study of the whole prehistoric period.

But the last eight chapters, having to do with the absorbingly interesting subject of the art of primitive man, are again excellent. Chapters XV, on cave art, and XVI, on decorated objects—the so-called *art mobilier*—are especially good. The somewhat limited geographical distribution of the surviving examples of the cave art is well brought out; but, as the author says, it is only in limestone areas that suitable caves occur, so that there may have been painting of a similar sort elsewhere, done on wood or other perishable materials (p. 205). Bison skins, with which Paleolithic man was undoubtedly well supplied, will suggest themselves to those familiar with the American Indian custom of painting on "buffalo robes."

An unusually happy addition to a work of this character is the glossary (pp. xviii–xix), giving the English names of the various types of Paleolithic implements, with their equivalents in French, German, and Spanish. The bibliography is comprehensive, up-to-date, and conveniently arranged, particularly in reference to dates of publication. An equal measure of praise cannot, unfortunately, be given to the index, which is both incomplete and inaccurate. Eoliths, for example, are mentioned repeatedly in the text, and that by no means solely in the chapter devoted to them; yet they are not listed in the index. Again, two of the most important references to copper in the entire book (those on pp. 33 and 37) do not appear, while one that is given (that to p. 160) is wrong. Numerous other instances of the same sort of thing could readily be cited.

It would seem that a good deal of the matter appearing in the footnotes might have been incorporated in the text, while many of the lists and tabulations scattered through the book, valuable though these all are, could have been relegated to an appendix with a distinct gain in readableness.

The forty-seven plates at the back of the book are well chosen; but regard for the convenience of the reader would have suggested their being inserted in juxtaposition to the particular portions of the subject matter which they are designed to illustrate.

By far the most serious defect in the book is the total absence of maps. There are literally scores of instances where even a sketch map in the text would have helped amazingly in showing the distribution of this or that race or culture element; and this is intended as no reflection upon Professor Burkitt's textual presentation of his subject, which is both clear and well ordered. Especially valuable would have been a map giving the geographical boundaries of the successive stages of the Upper Paleolithic; in no other way could the relationship of the peculiar and anomalous Solutrean to the preceding Aurignacian and the subsequent Magdalenian cultures have been so clearly brought out.

These drawbacks notwithstanding—and only the last-named is really serious—"Prehistory" forms a valuable addition to the literature in English dealing with the culture of the Old Stone Age. It should do much to stimulate interest in a line of research whose activities, thus far confined largely to western Europe, it is to be hoped will speedily be extended to embrace other portions of the globe that have been hitherto relatively neglected. For not in Europe, we may be assured, will be found the answer to the problem of man's origin.

C. W. Bishop

J. M. TYLER. **The New Stone Age in Northern Europe.** xviii and 310 pp.; map, ills., bibliogr., index. Chas. Scribner's Sons, New York, 1921. $3.00. 8 x 6 inches.

So much attention has been drawn of recent years to the Old Stone Age with its numerous and fascinating problems and its slowly unfolding picture of the life of its cave men and its mammoth hunters, that the succeeding period of the Neolithic has undeniably been slighted. Yet the significance of the latter to any reasoned study of the progress of the human race can hardly be overemphasized, for then it was that first appeared the germs of nearly all the basic elements of our own civilization. For this reason, as well as for its own manifold merits, Professor Tyler's book deserves a hearty welcome.

The text is divided into twelve chapters, of somewhat unequal merit. In the first, "The Coming of Man," the various stages of human evolution, physical and cultural, so far as we yet know them, previous to the commencement of the Neolithic, are well presented, although the enormous duration of this earliest period as compared with the succeeding ones might have been indicated with greater emphasis. More, too, might well have been said of the fundamental importance of the line of demarcation between the Lower and Upper divisions of the Old Stone Age. For it was then that the lowly race known as that of Neanderthal, which had so long inhabited Europe, was replaced by that of *Homo sapiens*, to which all existing races belong. Judged from this point of view, the break which occurred between the Mousterian and the Aurignacian subdivisions of the Paleolithic is of vastly greater import than anything that has taken place since in the entire history of man. Yet it is dismissed (p. 30) with less than four lines.

The influence of the former dense forest growth upon the spread of peoples and cultures over the face of Europe previous to the introduction of metal is well brought out in the third chapter, while the fifth, entitled "A Glance Eastward," contains an excellent account of discoveries in western Asia that tend to throw light upon the origins of different elements of Neolithic culture subsequently appearing in Europe. The importance of the widespread trade of prehistoric times receives due notice also, and the influence of geographical factors upon racial distribution and culture diffusion is well analyzed. This chapter is decidedly among the best in the book.

Not quite so much can be said of the following one, dealing with the question of megalithic monuments. It is perhaps hardly fair to criticize a book dealing with northern Europe because it fails to mention phenomena appearing in other regions. Still, since Professor Tyler himself mentions the existence of these constructions as far afield as India (p. 117), it is hard to see why he ignores their occurrence throughout the Indonesian and Oceanic areas, as well as in Japan, where they are so important that the protohistoric period there actually goes by the name of the Dolmen Period. Furthermore, the latest book dealing with this subject that is mentioned in the bibliography bears date of 1913, although very many of the most important investigations in this connection have been carried out since that year. The recent work of G. Elliot Smith and W. J. Perry, in particular, ought by no means to be passed over, even though one may not be prepared to accept all their conclusions.

The twelfth and longest chapter, devoted to "The Coming of the Indo-Europeans," is again one of the best in the book, but the subject is far too large a one to admit of a detailed discussion here.

A general criticism of the work might be that insufficient emphasis is placed upon the strictly communal character of the institutional and economic life of the Neolithic period, although it is true that this is touched upon to a certain extent (e.g. on pp. 275, 276). The "genuine farms" ascribed (p. 131) to the loess regions and the Danube valley, for instance, are likely to suggest to the lay reader the type of rural economy existing today in the British Isles, or in the United States, rather than the rigidly organized village community system, with its suppression of the individual in favor of the group, which actually prevailed.

The bibliography is avowedly incomplete, as indeed could hardly be otherwise. So far as it goes, it is extremely well chosen. It seems strange, however, that a book bearing date of 1921 should contain so few references to works published since 1914. The periodical literature of recent years also deserves more notice than it receives. The index, of only two scant pages, is quite inadequate to a book of this sort. A larger number of maps would seem to have been an improvement. In the one which does appear (facing p. 184), the likelihood of early human migrations from Asia to Africa having occurred right across

Arabia, or around the southern coast of that peninsula, is not indicated, while by some curious mischance the Syr Darya—the classical Jaxartes—is dubbed the Amur.

It may safely be said that "The New Stone Age in Northern Europe" forms a real addition to the literature in English bearing upon the Neolithic Period. Although not an original contribution to knowledge in the sense that it presents facts not hitherto published, it will undoubtedly prove extremely useful for the connected and well-drawn picture it gives of the period to which it is devoted. The author's style is notably attractive and readable. His book will well repay perusal, not only by professed students of the past, but by the public at large.

C. W. BISHOP

O. G. S. CRAWFORD. **Man and His Past.** xiv and 227 pp.; maps, ills. Oxford University Press, London, New York, Toronto, Melbourne, 1921. $4.75. 9 x 6 inches.

Mr. Crawford's book is an illustration of the growing feeling for the unity of knowledge that has of late found expression among a number of the students of man. It is the expression of the devout archeologist who sees in the ordered labors of his chosen work that "one stone the more swings into place" in the temple of knowledge; and who, furthermore, sees it in place in the structure as a whole. Thus the main portion of the book is occupied with discussion of the meaning of archeology and its relation to history, anthropology, and geography. Geography is the space aspect and as such the essential background for the study of any time aspect. It follows that emphasis is laid on the *changing* environment, and a word of caution is given to those who stress environment to the exclusion of all else. "Environment by itself can create nothing when the soil is unprepared. That is the explanation of so many geographical problems." History finds new interpretation and method with recognition of the space factor. Consider for instance the new orientation given to study of the later Middle Ages viewed as the culminating stage of a process of forest clearing that began in prehistoric times. And what is true for history is no less true for prehistory.

Portrayal of the geographical aspect raises the demand for maps, "as important to our knowledge of man's past states as are maps of the world today to the soldier or the economist, or even the politician, if he could but realize it." Not only does the archeologist seek the broad background to his detailed studies in environmental maps—an Atlas of Environment is called for—he must himself use the geographical method in prosecuting his researches. Distributions are as important as the objects distributed. Thus are determined the sites of ancient settlements, of trade routes, and movements of peoples (see Mr. Crawford's paper "Prehistoric Geography" elsewhere in this *Review*); and "the growing map is the source of all inspiration."

"Man and His Past" is concerned with no detail, it discusses no special region or period, save for the illustration of archeological method given in the chapter entitled "Roman Roads," from the author's immediate field of work. It is a view from the hilltops, a heartening and courageous view.

H. J. FLEURE. **Geographical Factors.** 31 pp.; bibliogr. (Helps for Students of History, No. 44.) Society for Promoting Christian Knowledge, London, 1921. 6d. 7 x 5 inches.

The thesis of Dr. Fleure's booklet is essentially similar to that of Mr. Crawford's "Man and His Past" (see above)—the fundamental fact of the unbroken continuity of human experience. The study of human experience involves the elements of "time" (history), "type" (anthropology), and "place" (geography). The danger of giving undue weight to one factor is illustrated by the view of environment as a control of human action in the narrow, determinist sense. For instance "without sufficient reference to the general world setting and the working of inherited momentum, it is but too easy to go astray and to 'explain' the Vikings of the fjords of Norway as the product of their environment without realizing the limitation of such views due to the fact that the Vikings are also characteristic products of a certain period."

The making of history has its correlative in the altering of environment; hence the need of maps of past as well as present conditions, maps requiring the co-operation of workers in several fields—historians and anthropologists and geographers. There is also the forward outlook, the changing environment of the future, a study that makes heavy demands now that "the effective environment" of each one of us is "nearly the whole world."

## A Popular Presentation of Polar Phenomena

Otto Nordenskjöld. **Polarnaturen.** xii and 143 pp.; maps, diagrs., ills., bibliogr. (Populärt vetenskapliga föreläsningar vid Göteborgs Högskola, Ny följd, No. 15.) Albert Bonniers, Stockholm, 1918. 4.75 kroner. 7½ x 5 inches.

In "Polarnaturen" Otto Nordenskjöld presents in a popular way, and in language that the layman finds intelligible and interesting, the phenomena of the polar worlds, both south and north, a task for which he is well fitted by his travels and studies.

The first chapter is devoted to the discussion of polar climates; their influence as geographic factors; the three types of polar climate—land type, sea type, and ice type—and their distribution; and a résumé of the subject. This is followed by a chapter on ice in polar lands, its occurrence, its origin, its distribution in various types and their significance, and ice-free districts in the polar region. In the third chapter the author discusses characteristic aspects of polar landscapes; the peculiar and widespread phenomena of solifluction and *polygonboden;* the character of polar flora and fauna and their ecology; and the evolution of life forms in polar lands. An attempt is made in the fourth chapter to define the limits of true polar and subpolar lands, and to divide them into natural provinces and belts, based upon climate, vegetation, and animal life, and such other natural phenomena as lend themselves to the purpose. The high arctic regions about the North Pole are given particular attention.

The cause of the glacial period and the phenomena connected with it in the light of present ice distribution and related phenomena constitute the subject matter of the sixth chapter, probably the most fascinating part of the book, while a final chapter is devoted to the effect of the glaciers upon the topography and landscape of Scandinavia, with considerable attention to such physiographic forms as fiords, terraces, cirques, strand plateaus, and hanging valleys.

In a peculiarly pleasing conclusion summarizing the characteristic phenomena of polar lands the author emphasizes the climate, the ice mantle, and the sparse vegetation as being the distinctive features of polar nature, and points out the significant and difficult problems still confronting the polar explorer.

W. Elmer Ekblaw

## The Development of Geography in the Nineteenth Century

Otto Nordenskjöld. **Geografisk Forskning og geografiske Opdagelser i det nittende Aarhundrede.** (Series: Det nittende Aarhundrede skildret af nordiske Videnskabsmænd, No. 19.) 159 pp.; maps, ills., diagr. Gyldendalske Boghandel, Nordisk Forlag, Copenhagen, 1920. 10 x 6½ inches.

Otto Nordenskjöld here gives a short treatment of the origin of modern geography at the beginning of the nineteenth century, its development up to the present time, and the exploration and colonization of the different parts of the globe. About half the book is devoted to the history of exploration. In one chapter the author deals with the mainsprings of such movement—economic gain, political conditions, scientific interests, etc. Under the head of scientific knowledge of the surface of the earth he treats of the mapping of the globe, division of the land, formation of the continents, origin of the types of landscape, structure and origin of mountains and rivers, formation of valleys, work of the ice, coasts, deserts, loess, coral islands, etc. Another chapter is devoted to climate, plants, and animals, with maps showing the distribution of temperature, atmospheric pressure, cyclones, precipitation, types of climate, phytogeography, and its development—zoögeography. Finally anthropology, ethnography, and anthropogeography are shortly touched upon.

E. Antevs

## A Visit to Crusoe Land

Carl Skottsberg. **Till Robinson-Ön och Världens Ände.** 208 pp.; maps, ills. Albert Bonniers, Stockholm, 1918. 15 kroner. 9½ x 6½ inches.

Robinson Crusoe's own book is hardly less entertaining than this interesting narrative of an explorer's visit to the Juan Fernandez group and Easter Island.

Financed by various societies and institutions of Sweden, the "Swedish Pacific Expedi-

tion" of 1916 and 1917 set for itself the task of studying the natural history of these islands and collecting as much museum and scientific material as possible. It was eminently successful in its object and repaid manyfold the time and money spent.

The route of the expedition lay by Christiania, Kirkwall, Panama, the western coast of South America to Chile, and finally to Juan Fernandez and Easter Island. Mas-a-tierra, the larger of the Juan Fernandez group, with Santa Clara, a tiny islet at its southern extremity, occupied most of the explorer's time. This mountainous island, with scarcely enough beach to afford adequate landing place, is about thirteen miles in length and four in width. Clothed in the most luxuriant vegetation, the mountains are difficult of traverse; but by determined effort the explorer sought out every nook and corner, wherever he might obtain anything of interest. The physiography, climate, plant and animal life all receive attention, but throughout his work the explorer does not lose sight of the human element; the culture and industries of the limited population are not neglected.

After completing his work on Mas-a-tierra and Santa Clara, the explorer visited Mas-afuera and gave it almost as careful attention as he did the larger island. Mas-afuera is even more mountainous than Mas-a-tierra, and high cliffs form its entire coast line. Every bit of research on this rugged lonely island demanded full toll of the explorer's strength and endurance, but he apparently enjoyed every moment. The visit to Easter Island was more cursory. A short note on the observations made here was published in the *Geographical Review*, Vol. 11, 1921, p. 448.

With a final chapter on Chile and a brief conclusion the book ends. Contour maps of Mas-a-tierra and Mas-afuera enhance the value of this excellent work.

W. Elmer Ekblaw

## A Textbook of Agricultural Meteorology

J. Warren Smith. **Agricultural Meteorology: The Effect of Weather on Crops.** xxiv and 304 pp.; maps, diagrs., ills., bibliogr., index. (Rural Text-Book Ser., L. H. Bailey, edit.) The Macmillan Co., New York, 1920. $2.40. 7½ x 5 inches.

This first American textbook on agricultural meteorology, by the foremost American authority on this subject, should not pass unnoticed or unused by geographers. At the outset Professor Smith presents in highly condensed form an illustrated exposition of elementary meteorology. Then follow chapters on agricultural meteorology and climatology. Methods of correlation are treated in detail as an introduction to the discussions of climate and crops, climate and farm operations, and weather and crops. The subject of the effects of weather on the various crops constitutes the bulk of the book; fiber crops, fruits, grains, and miscellaneous crops are considered in groups and individually. The closing chapters deal with weather forecasts and warnings, frost and frost damage, and the value of lightning rods.

As the author took great pains to get criticisms and advice from meteorologists and agriculturists the book is gratifyingly free of errors. Professor Smith was a teacher of agricultural meteorology for many years, and the book is well fitted for instruction. Paragraphs are short; illustrations well chosen, abundant, and mostly up-to-date (Fig. 73 is a glaring exception); and the scale and printing of the diagrams very satisfactory. At the end of each chapter are numerous suggestions for laboratory exercises and an extensive bibliography. Unfortunately for the teacher and more advanced student there are no references in the text to the particular publications in the bibliography. In all respects the book is easy to read and consult. It is eminently practical for the farmer, a useful reference book for the geographer, and a very interesting work for any reader.

Charles F. Brooks

## A Geographical Compendium of the Provinces of Spain

Benito Chias y Carbó. **Cartas corograficas.** 1296 pp.; maps, ills. (España Regional: Descripción Geográfica.) Alberto Martin, Barcelona, n.d.

Illustrative of the tendency toward intensive regional study of geography in Europe as in America is the work published under the above title. It was issued periodically and now comprises 120 *cuadernos*, as each section is styled. The work is regional ("chorographic" as the Spaniards say) in that it treats different districts separately. The "regions," however, are not purely geographic units, but rather political and historical, being the ancient kingdoms of Spain in the creation of which geography figured as one, but only one, of the

factors. These regions are distinguished neither by physiographic nor economic unity. Though more nearly resembling geographic regions than the present arbitrarily determined "provinces," they conform neither to the configuration of the land, the character of the soil, the differences in climate, nor to the human relations which arise from interchange of earth products. They were the result, in part, it is true, of the value of mountain barriers which divided the peninsula into easily defended petty kingdoms. But in modern times these natural features have largely lost their meaning as military assets and have taken on a new significance in the development of an agricultural and industrial nation. Hence the title is, perhaps, somewhat misleading.

The work is not modern, moreover, in its treatment, being almost entirely descriptive. Encyclopedic would very nearly describe its general character. In fact, so detailed is the description that it might almost be termed "topographic" in the British sense of the word.

There is an occasional reference to influence of soil, climate, and topography upon the character and distribution of vegetation or animal life, but little effort is made to show human relations to the land. Agriculture, industry, commerce, navigation, though described in detail, are not shown in their relation to geographic controls. The same may be said regarding the distribution of the people.

The maps accompanying the periodical issues of "España Regional" are of two kinds: plans of different cities in Spain and maps of the existing "provinces." The latter are of varying scale and are based on data supplied by the Instituto Geográfico y Estadístico. The information furnished by these maps is both full and up-to-date. Railroads, roads, canals, and telegraph stations are marked, as are also distances between road junctions and exact elevations so far as ascertained by the topographical surveys.

On the reverse side of every sheet are printed such data as lists of the wards in each city, elevation of points determined and the geographical co-ordinates ascertained by geodetic surveys. For the seaports lights, landmarks, etc., are shown.

## HOLLAND'S IMPORTANC AS A HORTICULTURAL LAND

H. BLINK. **Nederland als Tuinbouwland: Historisch en Economisch-Geographisch Beschreven.** Suppl. to *Tijdschr. voor Econ. Geogr.*, 1916, pp. 229–362. Maps, diagrs., ills. Mouton & Co., The Hague. 3 florins. 11 ½ x 9 inches.

To most Americans Holland is well known as a land of bulbs and flowers, but few there are who realize the extent to which all forms of garden and orchard culture have possessed Holland in the last half-century. In this volume, copiously illustrated with maps and photographs, Dr. Blink presents forcibly the eminent position that Holland holds among the gardening peoples of the world—in vegetable growing, in fruit culture, in bulb growing, and in seed production. He traces the history of the rise of horticulture in Holland, from a few first gardens kept by royalty to the present high stage of the art with over 13,000 florists, 3,500 bulb growers, 24,000 truck growers, and 6,000 tree culturists—a total of over 45,000 horticulturists within its narrow borders. In 1913 the horticultural societies of Holland numbered 294 with a membership of over 34,000. The extent of the industry is further illustrated by the fact that, in 1912, 4,768,300 square meters were under glass.

Perhaps nowhere in the world are so many kinds of vegetables raised and exported. Throughout the length and breadth of Holland, but more particularly near the coast, the land is dotted with vegetable gardens, where thousands of men, women, and children work industriously throughout the summer season. The phosphate beds of Florida and Algeria, the nitrate fields of Chile, and the potash deposits of Germany have all contributed to these garden spots of the Dutch. And then the gardeners send forth their fine fresh and dried and canned products to the far corners of the earth. (The reviewer of this article has eaten Dutch dried soups in northern Greenland.)

The culture of fruits and berries is scarcely second to olericulture. Every province of Holland grows great quantities of fruit, mostly inland. And here again the reader is astounded at the magnitude of the industry. Hundreds of thousands of square meters under glass—grapes, strawberries, peaches, apricots, and other fruits by the hundreds of tons. In 1913 Holland sent to England alone 28,512 hundredweight of apples; 66,006 of pears; 30,291 of cherries; 50,415 of currants; 4,396 of gooseberries, besides many hundredweight of other fruits and of nuts. And this was but a fraction of the export trade.

Even in tree and shrub culture the Dutch are unexcelled. Thousands of acres are given

over to the growing of shrubs and trees—coniferous, deciduous, fruit, nut, and shade trees; rhododendrons, azaleas, magnolias, clematis, roses, lilacs, palms, syringas, and hundreds of other species come under cultivation. In 1913 the foreign trade in trees and shrubs aggregated 43,192,577 pieces.

For two centuries at least the Netherlands have been known the world over for their bulb culture. As early as the fifteenth century the Dutch began introducing bulbs and other plants from foreign lands. Dutch maritime activity sent the ships of Holland to every land and port; lovers of flowers always, the Dutch sailors and adventurers brought back with them to their native land the most beautiful plants and flowers wherever they found them. The iris and the tulip were early introductions, and of the latter flower the Dutch became so infatuated that a veritable craze swept over the country in the seventeenth century. Over 140 varieties of tulips were grown at that time, and rare bulbs sold at fabulous prices. Following the tulip, the hyacinth, became popular. From its native home in Dalmatia, Greece, and Asia Minor, the hyacinth, after its introduction in Holland, soon spread throughout western Europe. It was in Holland that the large and beautiful varieties were developed, and the culture of both tulips and hyacinths was placed on a scientific basis. About the middle of the nineteenth century Dutch growers began exporting bulbs of all kinds in quantity. It was at this time that bulb culture and bulb trade assumed an important position in Holland's industries, a position which has constantly been strengthened, until in 1914 this industry ranked near the top among the productive and remunerative activities of the Dutch people. Most of the large bulb gardens lie along the coast. Here gardens of hundreds of acres are not rare, and in blossom time the coastal provinces become veritable gardens of the gods. In 1915 nearly 27,000,000 kilograms of bulbs were exported, of which 8,000,000 were shipped to America and 8,000,000 to Great Britain. Germany and Austria imported 4,000,000, Scandinavia 4,000,000, and the remainder were distributed to almost every land in the world.

Finally, Holland holds a prominent place in the growing of garden seeds, both vegetable and flower, though it is in the plants of the *Cruciferae*—radish, cabbage and its near relatives, turnip, and cauliflower,—spinach, beets, and beans, that most of the quantity is produced and most of the value received. Statistics indicate that in 1913 the Dutch seed gardens produced 2,000,000 kilograms of garden seeds, valued at 1,000,000 gulden.

The government and the many horticultural societies are carefully safeguarding the horticultural industries and trade. The best scientific knowledge and equipment are procured; well-planned publicity and propaganda are put out; the gardeners are given every opportunity for training and development; and cordial relations are maintained with every bulb-importing country. A determined effort is being made to stamp out every pest, every plant disease that may lead to embargoes or restrictions against Dutch products.

Holland is not likely soon to yield its dominance in horticulture to any other land. Favorable natural conditions, an industrious and frugal folk, and an intelligent government insure long years of supremacy.

W. Elmer Ekblaw

## A Brief Geographical Study of Denmark

H. P. Steensby. **Danmarks Natur.** Extract (Vol. 1, pp. 1–36) from "Danmark: Land og Folk: Historisk-Topografisk-Statistisk Haandbog," edited by Daniel Bruun. Vols. 1, 2, 3, 5. Gyldendalske Boghandel, Nordisk Forlag, Copenhagen and Christiania, 1919–21. 9½ x 6 inches.

This compact study by the late Professor Steensby condenses a wealth of geographic information regarding Denmark, valuable to every student of geography.

The extent of the country and its dependencies, its relative size and importance, its semi-insular character, its low relief, its many waterways, its history, its colonization projects, its ambitions constitute the first division of the book. Then follow in succession, brief, richly informative chapters on "The Danish Seas," with a review of Denmark's sea history and its sea influence; the "Extent and Population" of the land by provinces and sections, a valuable comparative study; "Terrain and Maps," a chapter which includes within brief compass the topography, the geology and the soil, and an account of the more important maps of the country from the earliest to the latest.

W. Elmer Ekblaw

## Erosion in the Driftless Area

A. C. Trowbridge. **The Erosional History of the Driftless Area.** 127 pp.; maps, diagrs., ills. *Univ. of Iowa Studies in Nat. Hist.*, Vol. 9, 1921, No. 3 (1st Ser. No. 40). University of Iowa, 1921. 9½ x 6½ inches.

The Driftless Area of southwestern Wisconsin, extending into adjacent portions of Minnesota, Iowa, and Illinois, is a field of absorbing interest to the student of earth sculpture, for here is a region, well within the drift-covered district of the United States, in which the products of normal subaerial erosion have been preserved intact. Since the early and well-known description of the area by Chamberlin and Salisbury a considerable number of articles have been devoted to certain parts of it, but few have taken up the erosional history of the district as a whole. Professor Trowbridge has studied many parts of the area, has been at work in it at intervals during a number of years, and is thus well qualified to speak of it as a whole.

His report is divided into two approximately equal parts, the first of which is entitled "Multiple Erosional Cycles in Principle." Here he gives an analysis and discussion of the evidences to be looked for which will indicate that a given district has undergone more than one cycle of erosion. These evidences are interrupted profiles of valleys, stream terraces, intrenched meanders, associated sets of straight and crooked streams, antecedent streams, wind gaps, even-crested summit areas, intermediate plains, and fluviatile deposits on uplands. Each of these evidences is analyzed in some detail, and the conclusion is reached that no one of the lines of evidence can be relied upon as absolute proof of more than one cycle of erosion, but that some lines of evidence are more convincing than others. In any particular area the combination of two or more of these lines of evidence should be relied upon to prove more than one cycle of erosion; and the more combinations, the more clear the proof.

The application of the above analysis to the Driftless Area shows that in that area the following evidences point to more than one cycle of erosion: Even-crested summit areas, intermediate plains, antecedent streams, entrenched meanders, associated sets of crooked and straight streams, stream terraces, and upland fluvial deposits. A feature of the Driftless Area is the presence of even-crested summit districts which mark a peneplain here designated as the Dodgeville plain. Above this plain rise a few erosion remnants. The Dodgeville plain slopes S. 23° E. at a rate of 3.3 feet per mile and is thus not in accordance with the nearly flat strata of the district, which have an average dip of 14.2 feet per mile towards S. 28° W. This plain bevels across, though at a very low angle, strata from the Niagara down to Prairie du Chien (Lower Magnesian), and the author considers the flat tops of the Baraboo quartzite ridges to belong to this same erosional surface. Lying about 200 feet below this plain is another, the Lancaster plain. This is the most prominent feature of the district and has, in the author's opinion, been confused with the higher plain. Into the Lancaster plain, which slopes 7.6 feet per mile towards S. 11° E., have been cut the valleys of the region, and some of their larger streams have markedly intrenched meanders.

The erosional history of the Driftless Area includes the formation of the extensive Dodgeville plain which the author considers to have been completed in Tertiary time—in late, rather than early or middle Tertiary time. This was followed by a slight uplift and the development of the Lancaster plain, which is of late Tertiary or possibly early Pleistocene age, for there is some evidence that this plain had not been dissected at the time of the deposition of the Pre-Kansan drift. Then an uplift of about 600 feet occurred, followed by the development of the present topography of early maturity. About the time of the Wisconsin drift the district was depressed approximately 180 feet.

An interesting feature of the paper is the explanation of the history of the Mississippi River between Minneapolis and Dubuque and the suggestion of this river's antecedent character.

U. S. Grant

THE
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# URUNDI, TERRITORY AND PEOPLE *

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Among the territories that have come into prominence as a result of the disposition of Germany's former colonial possessions none are possessed of a greater intrinsic interest than Ruanda and Urundi, the northwestern corner of late German East Africa. The climate is healthful, the scenery beautiful, the native population exceptionally numerous, intelligent, and industrious, the soil fertile, the natural resources varied and abundant. These regions are described by all travelers who have passed through them as lands flowing with milk and honey. And in fact this is true in the literal as well as the metaphorical sense. The writer will here record some of his observations in regard to Urundi, the more southerly of the two territories.

## EARLY EXPLORATION OF URUNDI

Burton and Speke came near the borders of "inhospitable Urundi" but did not enter the country.[1] Livingstone and Stanley passed along its Tanganyikan shores in 1871. In 1879 two white fathers established a mission at Rumonge, which in consequence of a massacre by the Warundi was abandoned in 1881. Other missionaries entered, and another station was founded in Uzige (a district about Usumbura) in 1884 and shortly afterwards abandoned because of Arab hostility. Subsequently successful missions were established, and to one of the missionaries in particular, Burgt, we owe much of our knowledge of the people, their customs, and their industries.[2] The first European layman to enter Urundi was Dr. O.

* Published with the permission of the Secretary of Agriculture.

[1] R. F. Burton: The Lake Regions of Central Equatorial Africa, *Journ. Royal Geogr. Soc.*, Vol. 29, 1859, pp. 1–464; reference on pp. 251 *et seq.*

[2] J. M. M. van der Burgt: Dictionnaire français-kirundi, avec l'indication succincte de la signification swahili et allemande, Bois-le-Duc, Holland, 1903. This volume is an encyclopedia as well as a dictionary. See also *idem;* Land und Leute von Nordurundi (Deutsch-Ostafrika), *Petermanns Mitt.*, Vol. 58, II, 1912, pp. 324–327 and Pl. 53.

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Baumann in 1892.[3] Since then a number of scientists, most of them German, have traversed portions of the country[4] and the adjacent and largely similar territory of Ruanda.[5]

## Boundaries and Area

The boundaries of the old German province are somewhat indefinite. It is separated from Ruanda on the north by the Akanyaru River and an indefinite line extending from its headwaters across and down a small river to the Rusizi River which drains Lake Kivu into Lake Tanganyika. The Rusizi River and Lake Tanganyika form the western boundary. At about 45 kilometers north of Kigoma the southern boundary runs east until it reaches the headwaters of the Mlagarasi River, which it follows in a northeasterly direction until the river turns sharply to the south. The boundary then extends northward in an irregular line until it reaches the Ruvuvu River, crosses to the Akanyaru, follows it a short distance, and turns west across the northern edges of Lakes Rugwero and Shohoho. According to German and British maps the area enclosed in Urundi is about 11,768 square miles; or, if we include an uncertain area to the northwest (above the dotted line on the sketch map, Fig. 1), it amounts to 12,298 square miles.[6]

## Topography and Drainage

Urundi as a whole is a mountainous plateau, a section of the high plateau land between Lake Tanganyika and Lake Victoria. It drops steeply some 3,000 feet on the western side to the shore of Lake Tanganyika and the bottom of the Rusizi valley, a part of the great western *Graben* or rift, of Central Africa. A few small isolated plains lie between the shore and the foot of the plateau slope. From the shore plains the edge of the plateau

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[3] Oscar Baumann: Die kartographischen Ergebnisse der Massai-Expedition des Deutschen Antisklaverei-Comités, *Petermanns Mitt. Ergänzungsheft No. 111*, 1894; *idem:* Durch Massailand zur Nilquelle. Reisen und Forschungen der Massai-Expedition des deutschen Antisklaverei-Komite in den Jahren 1891–1893, Berlin, 1894.

[4] Richard Kandt: Bericht über meine Reisen und gesammte Thätigkeit in Deutsch-Ostafrika, *Mitt. aus den Deutschen Schutzgebieten*, Vol. 13, 1900, pp. 240–264; *idem:* Caput Nili, Berlin, 1904; Hans Meyer: Ergebnisse einer Reise durch das Zwischenseengebiet Ostafrikas 1911, *Mitt. aus den Deutschen Schutzgebieten Ergänzungsheft No. 6*, 1913; Hans von Ramsay: Uha, Urundi und Ruanda, *Mitt. aus den Deutschen Schutzgebieten*, Vol. 10, 1897, pp. 177–181; G. F. Scott Elliot: A Naturalist in Mid-Africa, London, 1896. And see the bibliography to German East Africa in Hans Meyer: Das Deutsche Kolonialreich, Leipzig and Vienna, 1909–10, Vol. 1, pp. 407–416.

[5] Adolphus Frederick, Duke of Mecklenburg: In the Heart of Africa, transl. by G. E. Maberly-Oppler, London, New York, etc., 1910; G. A. von Götzen: Durch Afrika von Ost nach West, Berlin, 1895; Sir Alfred Sharpe: The Backbone of Africa (1920), reviewed elsewhere in this number of the *Review;* Jan Czekanowski: Forschungen im Nil-Kongo-Zwischengebiet, Vol. 3, Ethnographisch-Anthropologischer Atlas (Wissenschaftliche Ergebnisse der Deutschen Zentral-Afrika-Expedition 1907–1908 unter Führung Adolf Friedrichs, Herzogs zu Mecklenburg, Vol. 7), Leipzig, 1911; Capt. E. M. Jack: The Mufumbiro Mountains, *Geogr. Journ.*, Vol. 41, 1913, pp. 532–550.

[6] Paul Sprigade and Max Moisel: Grosser Deutscher Kolonialatlas, Berlin, 1901–12; Ruanda and Urundi, Africa in 1:1,000,000, *Geographical Section, General Staff, Map No. 2932*, War Office, London, 1919; [British] Report on Tanganyika Territory, covering the period from the conclusion of the Armistice to the end of 1920, Cmd. 1428, H. M. Stationery office, London, 1921.

Burgt, who lived in Urundi and who is responsible for the best topographic map of the northern part of the country (scale 1:200,000, Pl. 53 accompanying "Land und Leute von Nordurundi," *Petermanns Mitt.*, Vol. 58, II, 1912, pp. 324–327), does not show the dotted border line (Fig. 1).

is seen as a series of rounded and weathered hills, the slopes ranging from 10° to 35° and seldom showing rock outcrops. The lake shore strip and the

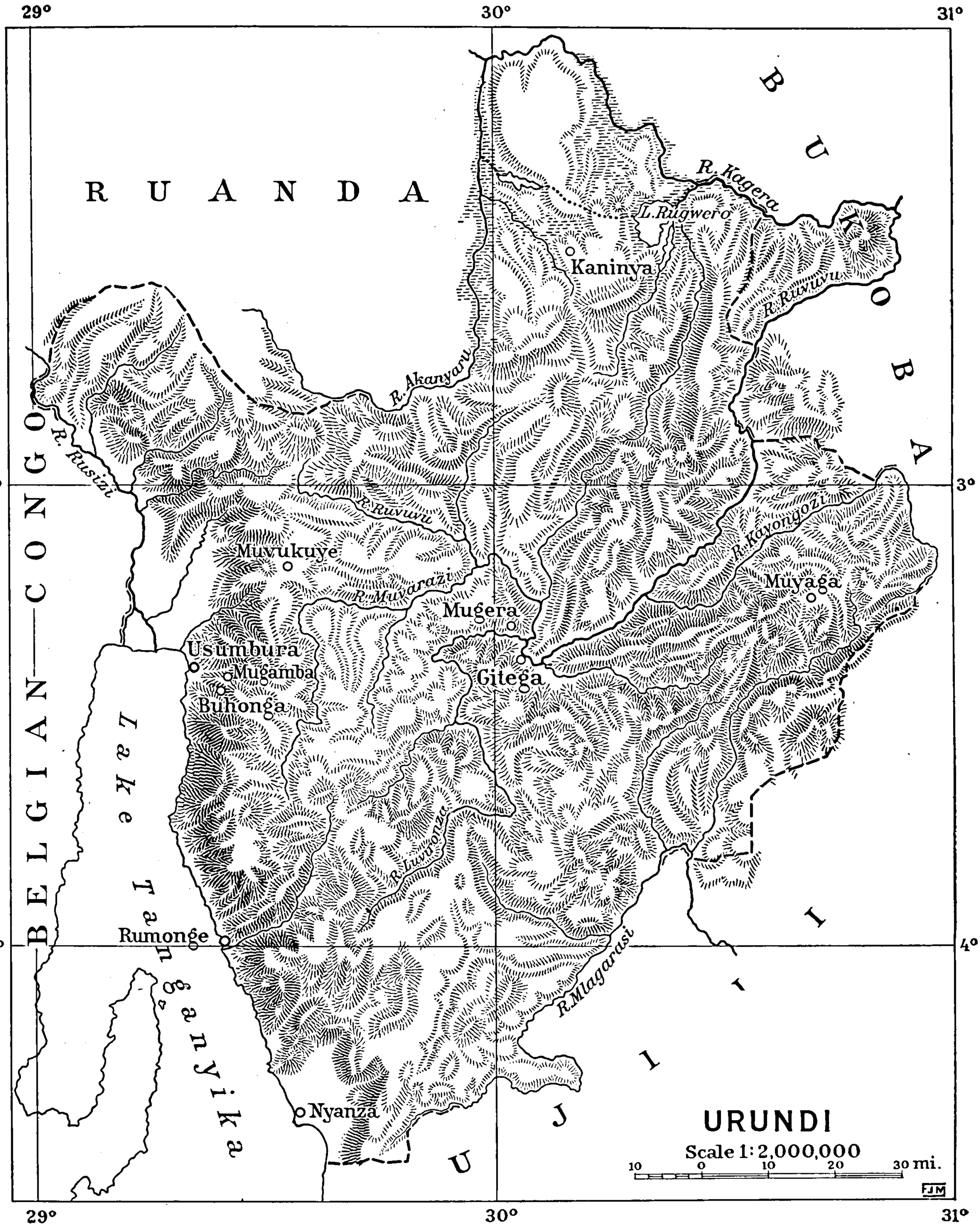


FIG. 1

lower valley of the Rusizi River are the lowest part of the country, the elevations here ranging from 2,500 to 3,400 feet. The western edge of the plateau (Randberge) rises to heights of over 8,000 feet, and the hilly upland that constitutes the rest of the country and descends gradually to the lower Victorian plateau averages between 4,500 and 6,000 feet above sea level:

The surface is everywhere thoroughly and deeply, but not sharply, dissected. The valley slopes are steep, ranging to 35°, but they are nowhere precipitous. The watershed ridges are unequal and differ in height from place to place on the same ridge. The inequalities on each ridge are in the form of evenly or smoothly rounded knobs, none of the profiles giving a serrate outline. All of the surfaces are smoothly rounded.

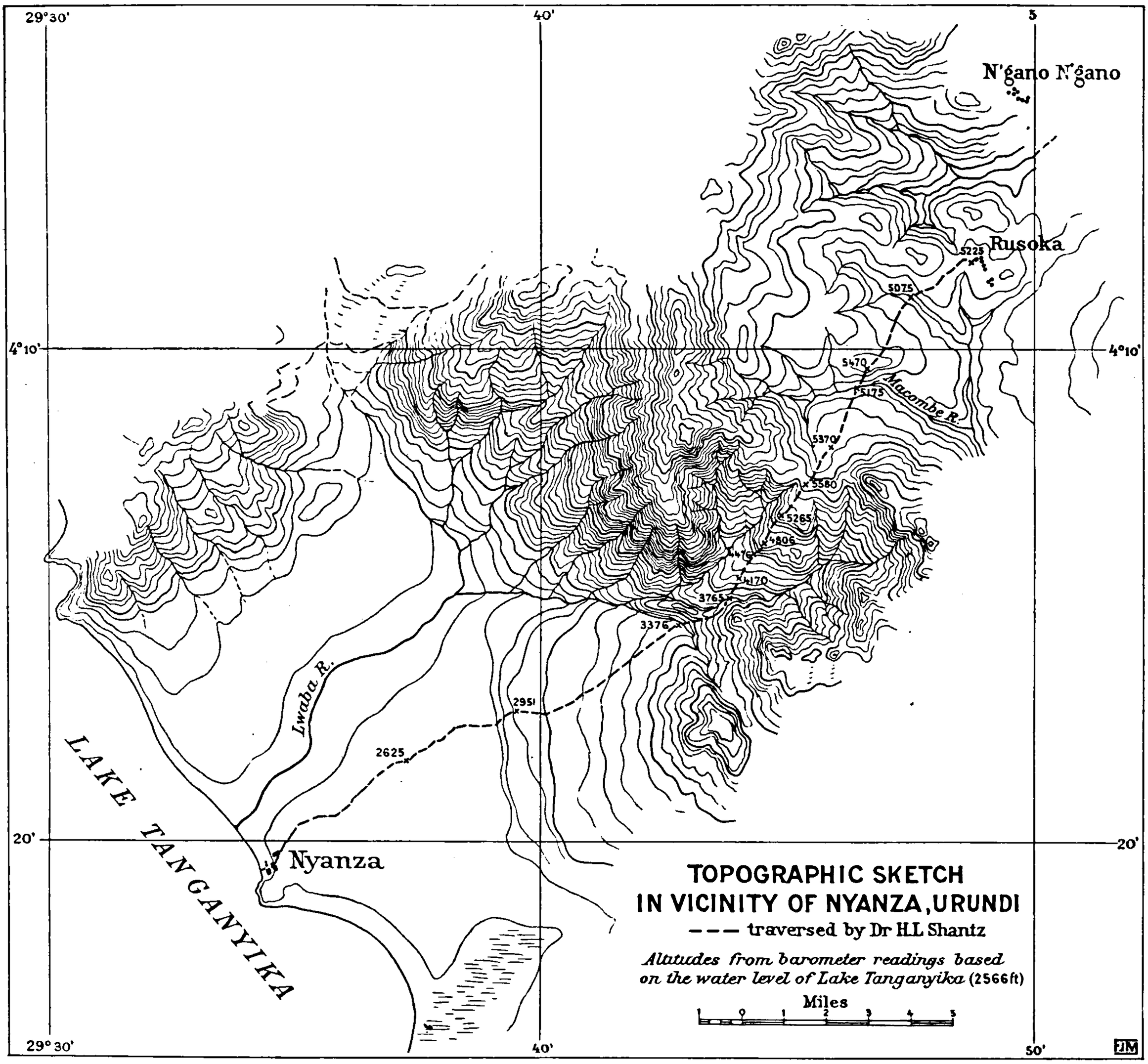


FIG. 2—Sketch map of a portion of southwestern Urundi. Scale approximately 1:350,000.

The rivers are still cutting down their beds, and the valleys are usually narrow. In the northeast, however, they flow through sluggish papyrus swamps. The drainage to the west is limited to a series of small streams which head in the edge of the plateau above the east shore of the lake. A small area in the southeast drains into the Mlagarasi, which swings south and west and empties into Tanganyika about 30 miles south of Ujiji. The drainage to the Congo thus constitutes about 38 per cent of the land area, Nile drainage constituting the remaining 62 per cent. The Nile-Congo watershed is marked in the north by the western portion of the mountainous plateau which runs parallel to the Rift Valley. In southern

Urundi it lies along a smoothly rounded area of high land, varying from about 5,700 to 6,500 feet in elevation, lying in a line drawn from Nyanza to Muyaga. While the Nyavarongo of Ruanda, a head stream of the Kagera, is now considered the source of the Nile,[7] some of the Urundi streams have also been claimants for this honor.[8] From Lake Victoria to the headwaters of the Muvarazi or Luvironza, tributaries of the Ruvuvu, is about 400 miles as compared with 430 to the headwaters of the Nyavarongo. The distance from the headwaters of the Ruvuvu to the mouth of the Nile is approximately 4,000 miles, while that from the headwaters of the Mlagarasi to the mouth of the Congo is about 2,300 miles.

FIG. 3—The more rugged portion of the western edge of the highland. Here there is a less smoothly rounded topography, but there are still no cliffs or precipices. The slopes are as great as 35° in places. A remnant of the temperate rain forest is shown in the center of the photograph. Over most of the areas are mountain grasses. Photograph looking north at about 5,265 feet elevation.

## CLIMATE

The most notable feature of the climate is the modification of temperature with altitude. Actual records, however, are very meager. According to De Greef[9] Gitega in the Ruvuvu valley at about 5,250 feet elevation showed an extreme range of from 61° to 79° F. (16°–26° C.) during the dry period, July 27 to August 19 (1918?), the minimum ranging from 61° to 65° F. (16° to 18.5° C.), and the maximum from 74° to 79° F. (23.5° to 26° C.). For the wet season, November 25 to December 15, the extreme range was from 54° to 79° F. (12° to 26° C.). The temperature of the region on the shore of Tanganyika is higher than in the upland. During the period

[7] Kandt, Caput Nili.

[8] Baumann, Durch Massailand zur Nilquelle.

[9] G. De Greef: Monographie agricole de la région de l'Urundi, ancienne province de l'Afrique orientale allemande, *Bull. Agric. du Congo Belge*, Vol. 10, 1919, pp. 3–69; reference on p. 10.

February 25 to March 21, 1920, inclusive, the temperature at Nyanza ranged from 65° to 86° F. (18.3° to 29.5° C.). The extreme range at Usumbura in 1912[10] was from 58° to 97° F. (14.3° to 36° C.). The rainfall is less abundant than in Ruanda, and there is a marked dry season. In general the dry season may be said to extend from June to October and the rainy season from November to May. The heaviest rains come in March and April. December is comparatively dry. In the lowlands drought affects the pasturage during the dry season, but in the mountains it is often green the year round.

Usumbura on the lake shore has an average rainfall (8 years) of 34 inches. The rainy season, November to April, is credited with a rainfall of 27.5 inches, the dry season, June to September, with 1 inch.[11]

TABLE I—RAINFALL RECORDS OF MISSION STATIONS [12]

| STATION | ELEVATION | LENGTH OF RECORD IN YEARS | AMOUNT OF RAINFALL IN INCHES |
|---|---|---|---|
| Kaninya (northern) . . . . | 4,900 | 5 | 39 |
| Mugera (central) . . . . . | 5,700 | 4 | 40 |
| Muyaga (eastern) . . . . . | 5,200 | 3 | 41 |

## SOILS

The soils of the mountain region are for the most part reddish loams or clays relatively uniform in color at different depths. Analysis of samples shows, contrary to what might be expected, that this is not an old lateritic soil but a younger soil, although the rainfall of about 40 inches has leached it of most of its soluble matter. It is, however, capable of producing excellent crops. In places erosion has removed almost all of the surface soil. Such crests show a deep brick-red color and can be seen for many miles. In fact, in the upland region about N'gano N'gano areas of red clay not covered by vegetation contrast sharply with the grass-covered hills.

The soil samples collected have been analyzed by the Bureau of Soils; and Dr. C. F. Marbut, Chief of the Soil Survey, gives the following discussion of the results.

The soil from the top of the plateau, No. 28,856, was taken from the surface foot, and No. 28,857 from 18 inches below the surface. The soil is a clay loam in texture with a low percentage of free quartz in fragments large enough for identification by the unaided eye. A considerable part of the silica present is combined silica and without much doubt is present in the form of aluminum silicate. The percentage of iron oxide is high, as well as that of alumina and combined water, the latter indicated by the rather high loss of igni-

[10] P. Heidke: Meteorologische Beobachtungen aus Deutsch-Ostafrika, Part IX, *Mitt. aus den Deutschen Schutzgebieten*, Vol. 27, 1914, pp. 85–188; reference on p. 103.

[11] H. G. Lyons: Climatological Studies—German East Africa, *Quart. Journ. Royal Meteorol. Soc.*, No. 182. Vol. 43, 1917, pp. 175–196; ref. on p. 193.

[12] Heinrich Schnee, edit.: Deutsches Kolonial-Lexicon, Leipzig, 1920, Vol. 3, p. 287.

tion. Part of this loss is due to organic matter but, on account of the small amount of the latter, not more than 3.5 to 4 per cent: the greater part of this loss consists of combined water.

A small amount of the water is combined with the iron, but the greater part is probably combined with the alumina, and the amount of both water and alumina is strongly suggestive of the presence of a small percentage of aluminum hydroxide. This is indicative in its turn of the operation of lateritic weathering in this region, the high rainfall of about 40 inches tending to confirm such a conclusion.

The low percentage of alkalies and alkaline earths indicates extensive leaching also. The soil corresponds in composition quite well with the red soils of the Piedmont regions of Georgia and Alabama. It is a good grass soil but under intensive cropping would require fertilization for best results.

TABLE II—CHEMICAL ANALYSES OF SOILS COLLECTED NEAR RUSOKA AT ABOUT 5,100 FEET ELEVATION

| ANALYSIS FOR | SOIL NO. 28,856 | SOIL NO. 28,857 |
|---|---|---|
| Silica, $SiO_2$ | 44.73 | 45.46 |
| Titanium dioxide, $TiO_2$ | 1.43 | 1.57 |
| Ferric oxide, $Fe_2O_3$ | 13.66 | 12.60 |
| Alumina, $Al_2O_3$ | 26.89 | 25.35 |
| Manganese oxide, MnO | 0.21 | 0.44 |
| Lime, CaO | 0.05 | 0.39 |
| Magnesia, MgO | 0.28 | 0.46 |
| Potash, $K_2O$ | 0.51 | 0.47 |
| Soda, $Na_2O$ | trace | trace |
| Phosphorus pentoxide, $P_2O_5$ | 0.21 | 0.33 |
| Sulphur trioxide, $SO_3$ | 0.03 | 0.05 |
| Nitrogen, N | 0.08 | 0.14 |
| Ignition loss, | 12.15 | 13.21 |
| Moisture, | 2.895 | 3.18 |
| Carbon dioxide, $CO_2$ | 0.00 | 0.00 |

Soil No. 28,856—High Urundi, 1 foot.
Soil No. 28,857—Under 28,856, 1½–2 feet.

On the lowlands, along the river bottoms, and on the narrow plain along the shore of Tanganyika the soil is rich deep alluvium, often sandy and darker in color. It produces excellent crops.

## VEGETATION

On a broad basis there are only four types of vegetation of importance in Urundi. First from the standpoint of area and usefulness is the *mountain grass*. It forms a great prairie occupying all of the land at higher elevations with the exception of relatively small patches of temperate rain forest. It consists of a rather dense growth of grasses usually from two to three feet high and constituting a continuous cover. The area is well supplied with rain for most of the year, and the grasses afford practically continuous

FIG. 4

FIG. 5

FIG. 4—Looking toward the top of the western edge of the plateau from an elevation of nearly 3,765 feet. All the ridges and crests are smoothly rounded, and the slopes vary in steepness. The highest point in this photograph rises a very short distance into the clouds. The vegetation is grassland with a few scattered trees, not confined to the water course but occurring anywhere either on the sides or crests of the hills.

FIG. 5—The plain bordering Lake Tanganyika at Nyanza, looking across the valley of the Lwaba River. Tanganyika is seen as a white band in the background at the left, the mountain north of Nyanza in the center, and the western edge of the plateau at the right. The vegetation in the foreground consists of Andropogon-like grasses, Crotalaria, and Borassus palms. In the lowland there are coarse grasses such as Sorghum. On the slopes of the mountains trees such as Acacia become prominent in the grassland. The many banana plantations and cornfields are not distinguishable from the natural vegetation.

FIG. 6

FIG. 7

FIG. 6—A general view over a smoothly rounded portion of the mountainous grass-covered plateau. About one-tenth of the grassland has been utilized for the production of bananas and other crops. The grove of trees (mostly Ficus) marks the *boma* of the sub-chief, Rusoka. About the *boma* are plantations of banana and fields of sorghum, elusine, beans, corn, sweet potato, etc. At the left are the huts of the Wahutu who serve the chief. The hill at the right is somewhat eroded, and the red soil shows through the grass cover. Looking east across Rusoka at 5,225 feet elevation.

fresh pasture, than which it would be difficult to find a finer anywhere. This type of vegetation occurs at high elevations about the great lakes and is especially extensive in Abyssinia. It occurs also on the mountains of Tanganyika Territory and in Kenya Colony, where it constitutes part of the "rangatan," or prairies of the high plateau, described by J. W. Gregory.[13]

Botanically the grasses have not been extensively studied. At N'gano N'gano the grassland is composed chiefly of the following species:[14]

*Hyparrhenia filipendula* (Hochst.) Stapf, one of the most important grasses of this highland and excellent for grazing.
*Trichopteryx* sp., one of the most important grasses, grown on the hills and 1–2 feet high.
*Sporobolus pyramidalis* Beauv., one of the important grasses, dominant on the lower slopes and grazed by cattle.
*Ctenium concinnum* Nees, one of the important grasses.
*Eragrostis cilianensis* (All.) Link, relatively important, limited on the drier slopes.
*Eragrostis chalcantha* Trin., " " " " " " "
*Microchloa indica* (L.) Kuntze, very abundant on hilltops but small and not a noticeable feature on the grassland.
*Themeda triandra* Forsk., a relatively important grass, although by no means of primary importance.
*Hyparrhenia rufa* (Nees) Stapf.
*Digitaria argyrotichia* (Anderss.) Chiov.
*Aristida* sp.
*Tricholaena rosea* Nees.
*Eragrostis* sp., a ruderal.
*Eragrostis collocarpa* Schum., a semi-ruderal of some importance.

The mountain grass furnishes practically the only food for the great herds of cattle. Although the country is densely populated, most of the land is left in the natural sod. In the region visited by the writer only about ten per cent was under cultivation.

## Temperate Rain Forest

The temperate rain forest of Urundi is now limited to two small areas, one northeast of Rumonge and another northeast of Usumbura, and to many small patches on steep or sheltered slopes naturally protected from destruction by primitive man or by fire or preserved as sacred groves. The great tall white trunks of the trees stand out and can be seen for miles. The principal trees of this type of forest noted by Mildbraed[15] in Ruanda, probably the same as in the Urundi forests, are *Olea hochstetteri* Baker, *Macaranga kilimandscharica* Pax, *Podocarpus milanjiana* Rendle, and *Hagenia abyssinica* J. F. Gmel. Meyer, who crossed Urundi from east to west and west to east, collected the following in the temperate forest: *Olea hochstetteri* Baker, *Macaranga kilimandscharica* Pax, and *Hagenia abyssinica* J. F. Gmel.[16] These small forest patches are remnants of the

[13] J. W. Gregory: The Great Rift Valley, London, 1896, p. 289.
[14] Identified by Agnes Chase.
[15] J. Mildbraed, edit.: Botanik (Wissenschaftliche Ergebnisse der Deutschen Zentral-Afrika-Expedition 1907–1908 unter Fuhrung Adolf Friedrichs, Herzogs zu Mecklenburg, Vol. 2), Leipzig, 1914, p. 623.
[16] Hans Meyer: Ergebnisse einer Reise durch das Zwischenseengebiet Ostafrikas, 1911, *Mitt. aus den Deutschen Schutzgebieten Ergängungsheft No. 6*, 1913, pp. 93–101.

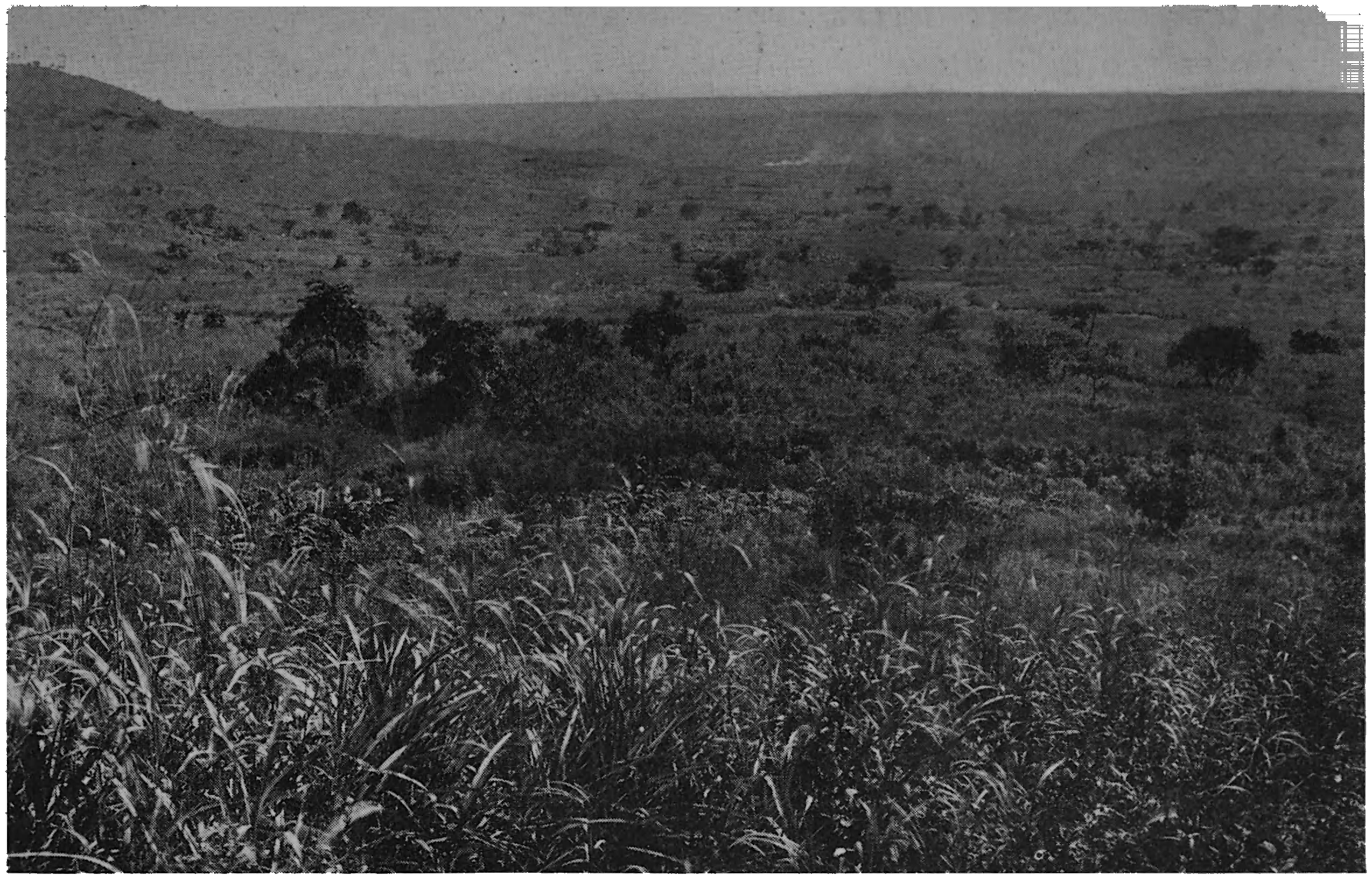

FIG. 8

FIG. 9

FIG. 8—A general view over the plain at Nyanza taken from near the base of the mountains. It shows the tall grass with scattered trees. Typical acacia-tall grass country.

FIG. 9—The bank of the Lwaba near Nyanza. The coarse grasses are mostly Sorghum and Arundinaria Natives are here shown crossing the stream and filling the pots which they carry on their heads.

great temperate rain forest or yellowwood (Podocarpus) forest which dominates the high mountain forest land of East Africa. Formerly this forest must have been much more extensive. It has been invaded by the natives, seeking new land for agriculture and pasture.[17] Much of the mountain grassland would probably revert to forest were it not for the constant burning and grazing. A considerable use is made of the remaining forest: it furnishes clothing, utensils, and wood or fuel in the shape of bark cloth, wood, and charcoal.

### Acacia-Tall Grass

This type occurs along the lowlands on the west and about the northern and eastern boundary lines. It consists of tall grasses three to five feet high, which do not form a sod but cover the ground much as does a cereal crop when sown broadcast. Scattered through this grassland either singly or in clumps are trees of moderate size, seldom over 30 to 40 feet high, often with flat, widespreading top, giving a landscape with a parklike or orchard-like appearance. The grasses are chiefly *Hyparrhenia filipendula* (Hochst.) Stapf, *Themeda triandra* Forsk., and *Cymbopogon giganteus* (Hochst.) Stapf.

On the plain just back of the shore of Lake Tanganyika, palms form a conspicuous part of the vegetation. Borassus is quite abundant, and the oil palm, which has been planted throughout the grassland, has the appearance of being a part of the natural plant cover. Wood and bast fiber are secured here. The bast fiber is constantly used whenever string or rope is needed. The acacia-tall grass areas are not as well suited to cattle as are the mountain-grass areas, because of the poorer forage, long drought period, higher temperature, and greater prevalence of disease. Goats, cattle, and sheep are kept in this region. Tsetse fly occurs along the shore of Lake Tanganyika.[18] At Nyanza on the shore of Lake Tanganyika the Belgian officer had, however, an unusually fine herd of cattle that received excellent care.

### Marsh Grass

Wherever water stands over the surface, as along the river bottoms of northern and eastern Urundi, the marsh-grass type of vegetation occurs. Here are luxuriant areas of papyrus (*Cyperus papyrus* L.), which is abundant in both the highlands and lowlands of equatorial Africa. Great areas of *Andropogon arundinaceus* (Willd.) Stapf occur on the alluvial land of the plains about Nyanza. Here also occur *Imperata cylindrica Thunbergii* Dut. & Shintz, *Phragmites communis* Trin., and other coarse grasses.

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[17] Compare C. H. Stigand: The Lost Forests of Africa, *Geogr. Journ.*, Vol. 45, 1915, pp. 513–520; and D. E Hutchins: Report on the Forests of British East Africa, Cd. 4723, London, 1909.

[18] De Greef, *op. cit.*

## Wild Animal Life

In contrast with conditions on the grassy steppes further east wild animals are not abundant in Urundi as a whole, although along the shore of Lake Tanganyika the smaller antelope, especially such forms as waterbuck, reedbuck, bushbuck, are numerous. The country in fact is too densely inhabited to permit of great numbers of wild animals. The Watusi do not eat wild game and pay little or no attention to it. They[19] regard the wild animals as men transformed for crimes committed during their human inhabitation of this world. Lions are supposed to be kings, while leopards are princes. Leopards and leopard cats are killed for their skins, which form a distinctive feature of the gala dress of the Watusi men. Elephants occur in the Rusizi valley. Rhinoceroses occur quite frequently along the southeastern border.

## Inhabitants

Urundi is estimated to have a population of 1,500,000 people. Since the total area of Urundi is only 12,298 square miles, this means an average of 122 persons per square mile for the whole area. The Resident, P. Ryckmans, has stated that in certain sections of the country there are 100 persons per square kilometer, or 260 per square mile. The region is therefore densely inhabited, in which respect it contrasts markedly with other regions of Central Africa.[20]

The Warundi, or people of Urundi, comprise three races: the Watusi, the Wahutu, and the Watwa (Batwa). Authorities differ as to the relative proportions of these races. Burgt[21] gives for northern Urundi 20–30 per cent Watusi, but in his "Dictionnaire"[22] he gives 10 per cent as the relative number of Watusi. De Greef[23] and Franck[24] agree with Burgt. In a short report of an address by Ryckmans,[25] Resident of Urundi, the Wahutu are said to constitute 95 per cent of the total population, which would leave less than 5 per cent for the Watusi. Ten per cent seems a fair general estimate.

The Watusi constitute the dominant race and closely resemble the Bahima of Ankole (Uganda Protectorate) and other cattle-keeping aristocracies of east-central Africa and are generally believed to be of Hamitic origin from Galaland or to be the descendants of the early Egyptians. They have subdued the Bantu occupants of the countries into which they have spread.[26] The Watusi are a wonderful people. The men are tall—five feet

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[19] Burgt, Dictionnaire, p. 33.

[20] See for comparative purposes the density of population map in Hans Meyer: Das Deutsche Kolonialreich, Vol. 1, 1909, p. 80.

[21] Burgt, Land und Leute, p. 324.

[22] Burgt, Dictionnaire, p. 4.

[23] De Greef, *op. cit.*, p. 36.

[24] Louis Franck: *Le Mouvement Géographique*, Oct. 23, 1921.

[25] *Bull. Soc. Royale de Géogr. d'Anvers*, Vol. 41, 1921, p. 194.

[26] Sir Harry Johnston believes that they may have originated in Egypt, an opinion not concurred in by C. G. Seligmann. See H. H. Johnston: A Survey of the Ethnography of Africa, *Journ. Anthropol. Inst.*, Vol. 43, 1913, pp. 375–421; especially pp. 419–421.

ten inches to seven feet two inches in height.[27] They are slender, athletic, with long faces, aquiline noses, and relatively thin lips. Their color is a chocolate brown to almost black. They are clean-faced and usually have shaved heads. Their eyes are clear and full of fire, and the expression is animated. Although they have had very little contact with the white race they show an intelligent and lively interest in the works of the white man and an appreciation of his knowledge. They are a race to be admired, and the traveler is glad to associate with them.

FIG. 10—Chief Ararawe (right), his son, and nephew. They wear a garment of calico, "Americana," over the bark cloth dress with raphia or banana fiber epaulets, a cloth band round the head, and on top a small wizard's vial, in Ararawe's case replaced by a green glass stopper. The white shell worn by the chiefs is seen on Ararawe's neck.

The manners of this people are exceptionally good. When they meet each other they give appropriate greeting. Among the chiefs this consists of a series of salutations while holding each other by the shoulder or elbow with both hands. According to Burgt a man says to his chief, "I sho, sho, sho, gir inka" (I hope your cattle are doing well). The reply is, "Eeh, eeh" (I hope yours are also). Since this people's regard for the cow amounts, as it did among the Egyptians, almost to worship, it is not surprising that salutations should take this form. The greeting is at times very long, lasting several minutes. It is subject to many variations, depending largely on the social position and relationship of the two men. It is carried on in a low tone, audible only within a few feet of the speaker.

The salutation between two men meeting for the first time in the day would run about as follows:

A. Mwakeye? (Good day?).
B. Mwakeye (Good day).
A. Amahoro? (All is well?).
B. Amahoro (All is well).
A. Uragumye? (And the women?).
B. Ndagumye (The women are well).
A. Neza (It is well).
B. Neza (It is well).

The greeting of the white man who understands none of the native language is generally carried out about as follows. The chief will first place on the ground the spear and bow and arrows which he always carries.

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[27] Duke of Mecklenburg, *op. cit.*, p. 48.

He will then approach the white man and shake hands, while clasping the white man's hand in both of his.

The Watusi are wonderful athletes. Tall and lank, they excel in jumping and are also capable runners. In the high jump, with a small termite hill as a start, they clear a string at a little over eight feet.[28] They can easily jump over a tall man and over several cattle. As bowmen they shoot with terrific force but not very accurately. This lack of accuracy may be partly due to direction of attention to their prayer which is chanted dramatically while they hold the drawn bow. They also hold the long spear in the hand which draws the bow. In throwing the spear, which also is done with great force, they are much more accurate.

FIG. 11—Watusi dressed for the dance. Each wears an undergarment of dark bark cloth and a leopard or leopard-cat skin over the shoulder and around the loins. Around the ankles are dozens of small wire anklets. The white headdress is a piece of hide with the long hair standing out around the head.

In the dance the Watusi are entirely free from the bodily contortion so characteristic of negro dances. A large body of men elegantly dressed, each carrying a long bow and spear, move together as one man, the rhythm being perfectly maintained and made audible only by the rapid tapping of the feet and the swish of thousands of soft wire anklets. In front of the line of dancers one or more of the chiefs moves back and forth directing the dance. The whole is a great ballet unexcelled in grace and rhythm. At times the whole mass rises into the air in a high jump, but at no time is there any show of exertion. In one of the most impressive stages all kneel down on one knee and a poet recites the heroic deeds of the chief and his tribe.

## THE SUBJECT WAHUTU

The Watusi own the cattle, control the land, and employ the Wahutus to do their work. The Wahutu are a Bantu race constituting, according to different authorities, from 65 to 95 per cent of the population. They are a subdued people and have been profoundly influenced in their manners

[28] *Ibid.*, p. 59.

and customs by the Watusi who entered the country several hundred years ago. They are tall, brawny, agile, active, and largely devoted to agriculture and trading. They would probably be pastoral if it were not for the Watusi, who have pre-empted this privilege. The more influential men of Wahutu often own one or two cows. Burgt (1912) regards them as far above the ordinary Bantu in intelligence. They accept with less reserve than the Watusi the teachings of the missionary and are regarded as more promising or pliable material on which to graft

FIG. 12—A Watusi dance. About 500 men are here taking part in a dance that reminds one of a great national ballet and is entirely unlike the usual negro dances. From one to six solo dancers are in front of the main line. In the photograph Chief Ararawe and his nephew are seen.

our customs, virtues, vices, and beliefs. If the country should be overrun by whites the Bantu would change gladly from the subservient position he holds with reference to the Watusi to a similar position with respect to the whites, while the Watusi with his racial pride and feeling of superiority would probably resent to the last an unjust domination.

There are no slaves in Urundi; and the position of the Wahutu is by no means a bad one, since they are recognized by the king and granted many privileges.

## THE PYGMY WATWA

The Watwa are a race of pygmies dependent largely on hunting and are despised and called beasts by Watusi and Wahutu alike. They have probably occupied the country longer than any other tribe. They constitute less than five per cent of the total inhabitants and are especially numerous in the forests and along the river bottoms. They are nomadic, timid, cruel, fierce, and aggressive in war. The Watusi call them in derision "sons of the

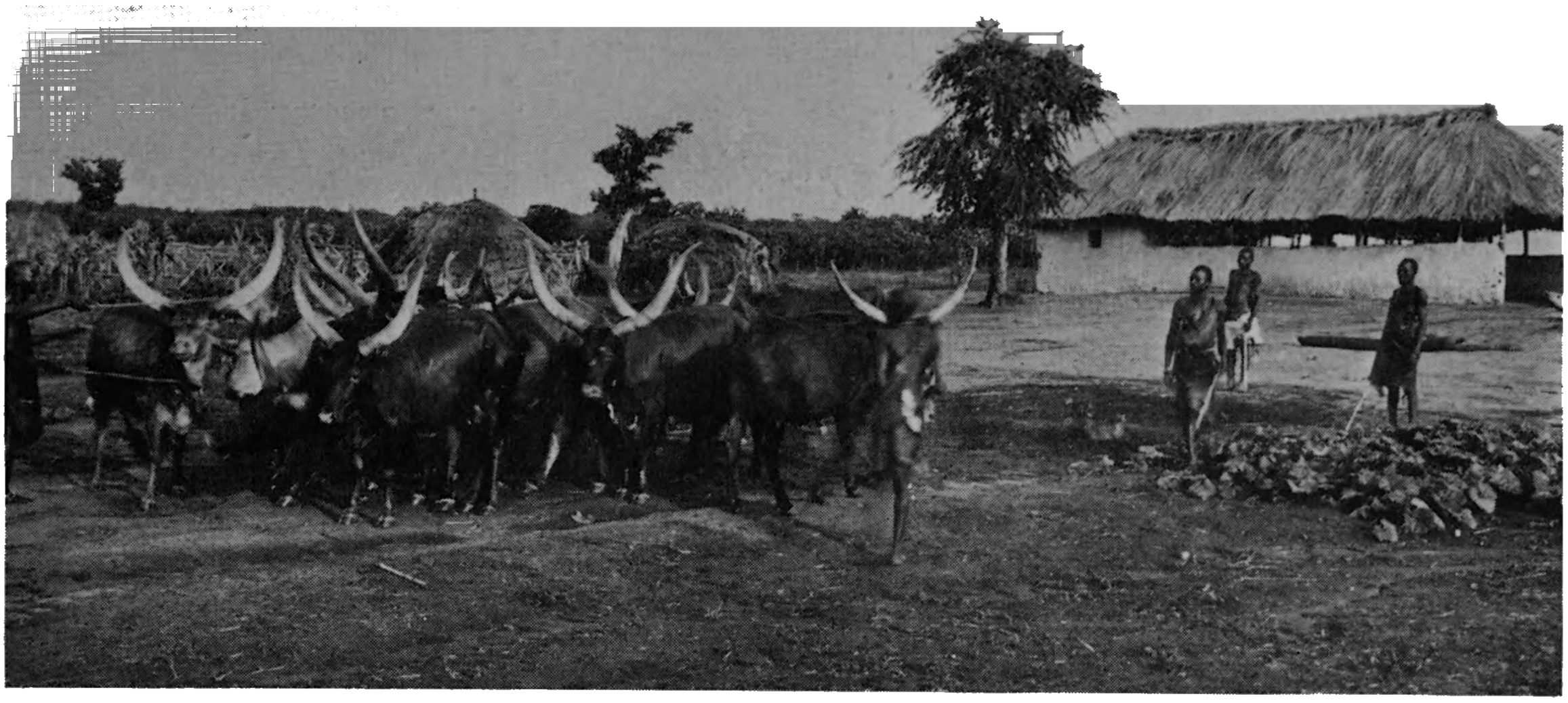

FIG. 13

FIG. 14

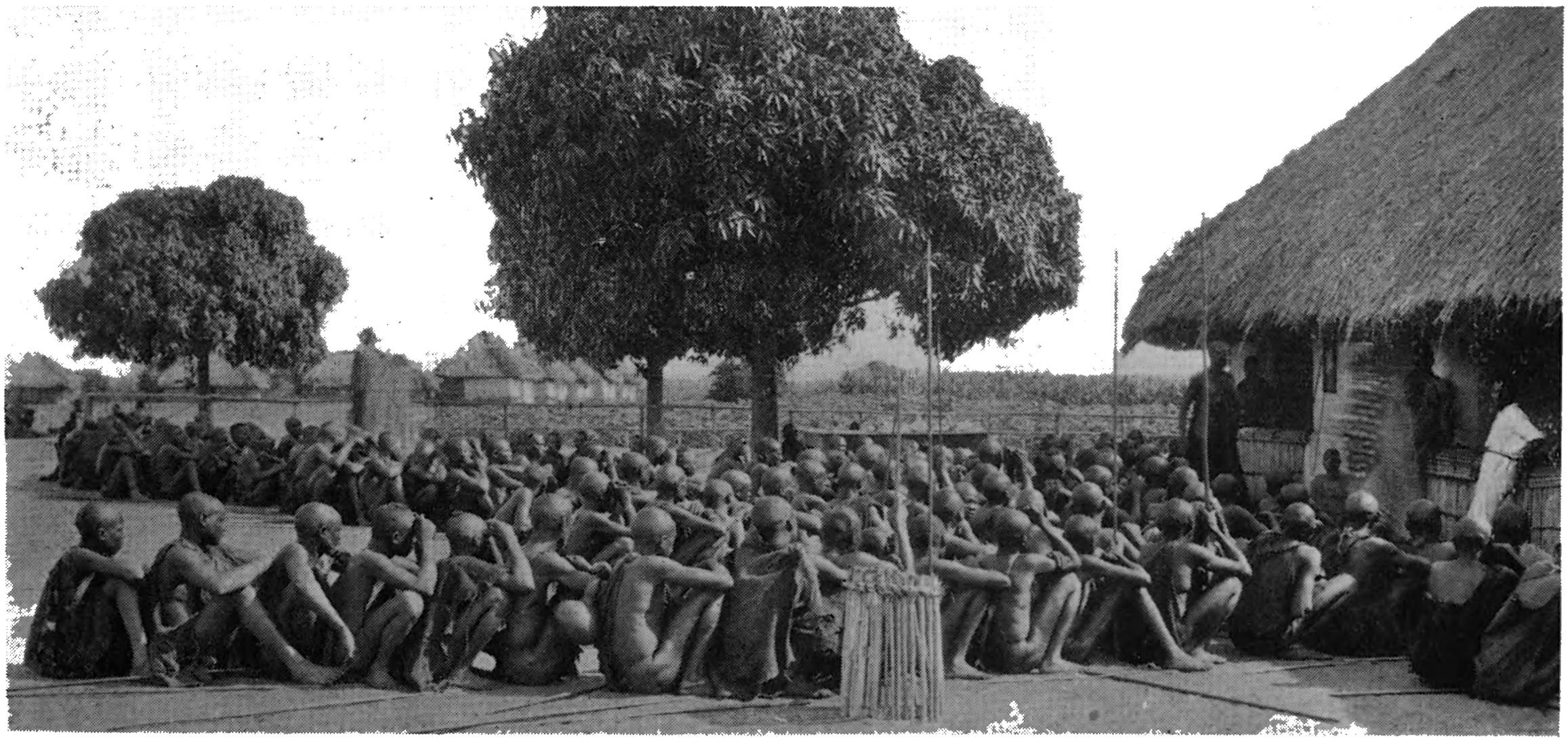

FIG. 15

FIG. 13—The chief interest of the Watusi is their cattle. These are large-bodied animals with unusually large horns (in general about 3 feet long). The cow shed at the right, which was constructed on plans submitted by the Belgian authority, is not typical of the huts used by the Warundi.

FIG. 14—Wahutu hoeing. They work more or less in unison and to song. At the beginning and end of the day's work they form a dancing party, using the hoe instead of the spear, and greet the Belgian officer for whom they are working.

elephant," "murderers," "tanners," etc., while the Watwa call themselves "sons of men."

## Animal Industry

Cattle raising is the most outstanding feature of native industry. The Watusi are primarily cattlemen, and no land could be better adapted to that pursuit. It is a high, cool country, free from diseases ordinarily affecting cattle in the lowlands, and a great natural grassland furnishing forage throughout the year.

FIG. 16—Various types of baskets. The tall basket at the right is very light and has a design made by the use of a dark varnish-like material. Next to it are two well woven grass baskets of which the tops and bottoms are much alike and fit tightly together. At the left is a heavy double basket used to carry produce purchased in the market. The basket next without a cover is used in making cassava flour. At the right is shown a wooden container used especially in making palm oil. A woven sack is shown in the back at the left.

In this tribe, as among other cattle-keeping aristocracies of eastern Africa,[29] the regard for the animals amounts almost to worship and results in the greatest protection and care. The cattle (inka) are large, well-shaped, with enormous horns and large bodies indicating a foundation in the big-horned African race. The appearance of many of them is the same as those pictured in the Egyptian tombs and temples. They are valuable as beef cattle, although inferior to those of South Africa. The cattle are herded, as a rule, by the boys and are brought into the *boma* of the chief at night. Brands are apparently not used. The Watusi have a lengthy vocabulary[30] describing each type of cattle, corresponding somewhat to our terms—longhorn (inyambo), hornless or small-horns (ikongo), red (ikihogo), white (ikihororo), black (umugeyo), milch cow (inka u'amasa), heifer (icyacyi), etc. They assign to each animal a proper name, such as Nazoba, Kimonge, Mugamba, Ntaha, Rutangiriwangirye, Muvumuwavyayevyambu, etc.

The Watusi do not eat the meat of other domestic animals or of wild animals. This limits their meat diet to beef, of which they are very fond.

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[29] Compare the Bahima and Banyoro of the Uganda Protectorate. See John Roscoe: The Northern Bantu, Cambridge, 1915.

[30] Burgt, Dictionnaire, p. 76.

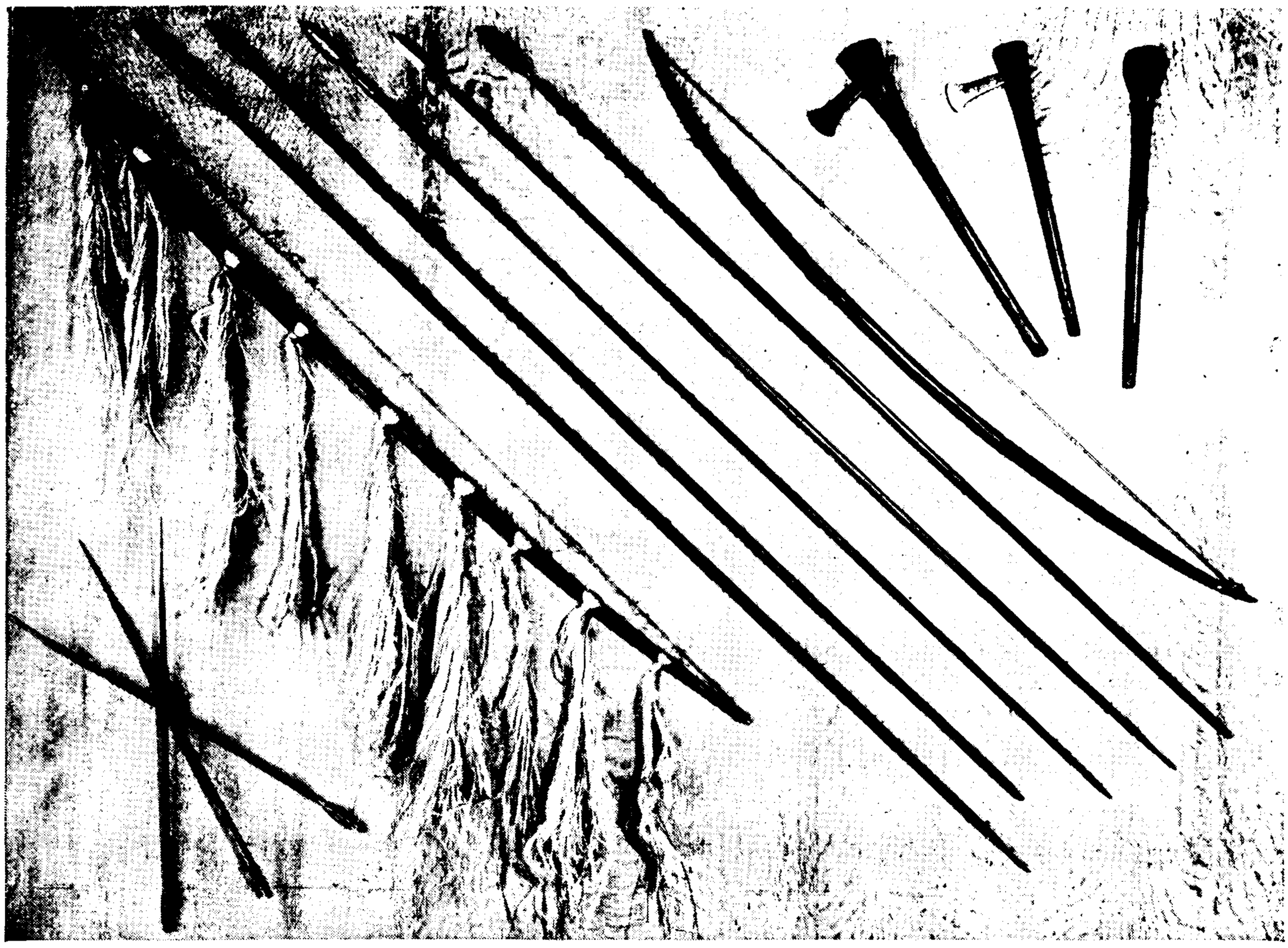

FIG. 17

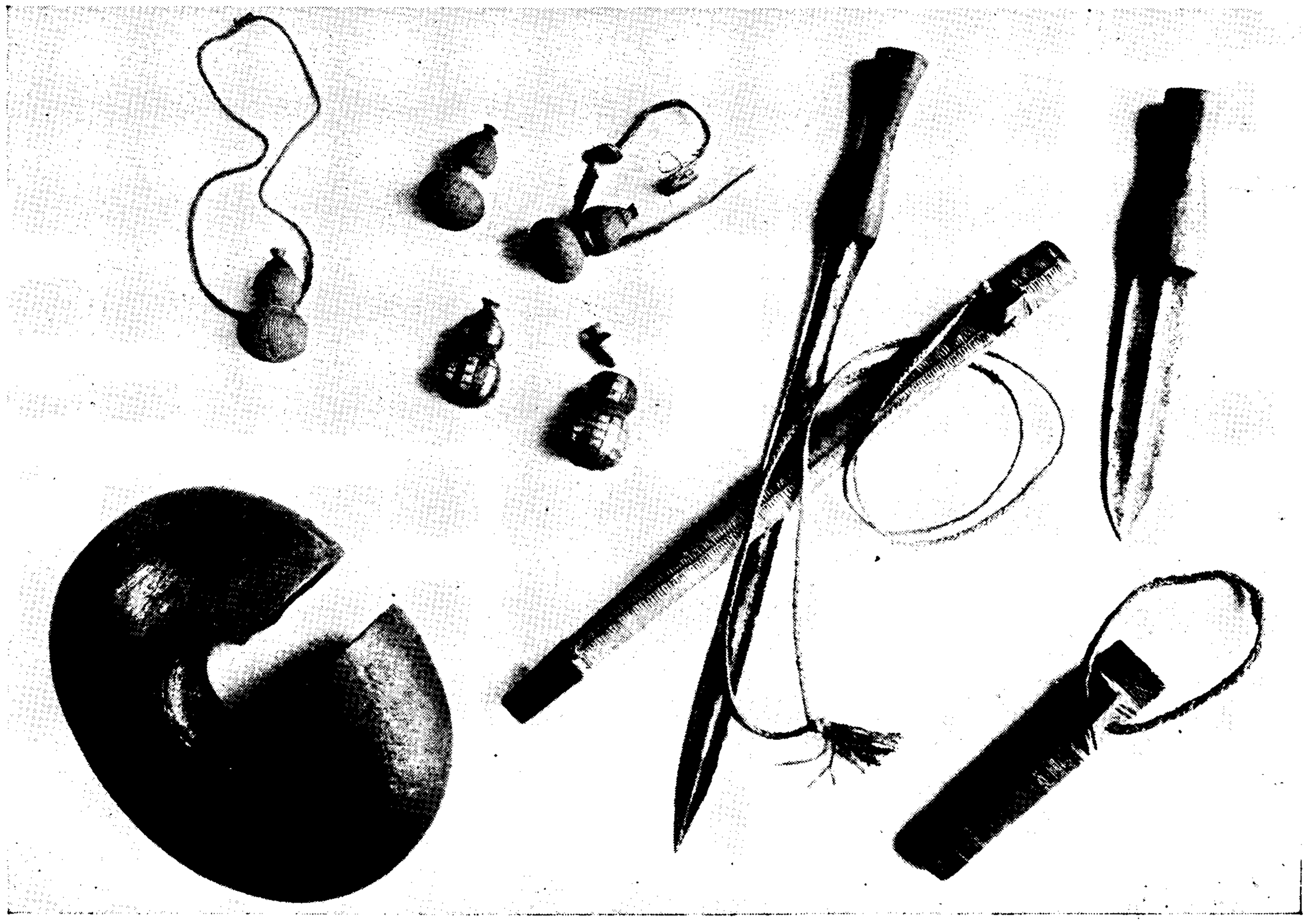

FIG. 18

FIG. 17—The principal weapons of the Warundi. Beginning at the left are three arrows used by the Watusi; a Watusi bow (six feet long) decorated with banana fiber; five small-headed spears; a bow of the Wahutu made of dark wood and with a carefully made bowstring; two axes and a club. Almost every native carries an ax or a club and a spear or two.

FIG. 18—At the left the large wooden wristband used by Watusi bowmen to protect the hand and thumb

According to the Belgian *chef de poste* at Nyanza they previously consumed the hides as well as the meat and blood, but this custom has been stopped by the Belgians in order that the hides may be exported. They bleed their cattle in much the same manner as the Masai but usually eat the blood cooked with beans.

These cattle produce relatively little milk, from a liter to a liter and a half a day. The average production of milk per cow for a herd ranging from 12 to 54 in number for 11 months at Nyanza[31] was 0.95 liter per day. The yield in butter amounted to only a tenth of a pound per day. The men do the milking, twice a day, at noon and in the evening. A wooden vase rounded on the bottom, about a foot long and four or five inches in diameter, is used to receive the milk. The vase is first cleaned with fresh cow urine. The calf is allowed to feed for a few moments, then the hind legs of the cow are tied, and the calf is led away. Usually several men engage in the milking, one or two to hold the calf, one to quiet the cow, and one to protect it from insects while still another does the milking. The milk is drunk both fresh and curdled. Most of it is used to make butter. This is done by rocking a calabash which contains the sour milk and cream back and forth until the butter is formed. Butter is never eaten by the natives but is used to smear over the body. It is, however, one of the chief export commodities.

There are estimated to be about 250,000 cattle in Urundi. They are therefore not numerous; but they are by far the most important economic asset, judged either by Watusi or European standards.

As compared with cattle all other domestic animals play a relatively unimportant part in the agriculture of the Warundi. Next to cattle goats are the most important. Both goats and sheep are kept, but only for trade. They are never eaten. The same is the case with chickens, which are rare in the interior of Urundi. Dogs are common. Cats and hogs are almost unknown.

Bees (inyuki) are kept by the Warundi. The hives are made from tree trunks or from papyrus or palm fiber. They are usually cylindrical, four to five feet long and about a foot and a half in diameter, and are usually hung from the limbs of trees. A swarm in the air[32] is brought to the ground by loud cries and by throwing water or dust among them. The honey is taken out at night with the use of smoke.

## Plant Industry

The Wahutu are primarily agriculturists, probably not by choice, as has been said, but because they have been forced to give up the cattle to the dominant Watusi. The Watusi are, however, intensely interested in agriculture; the women, the men, and even the chiefs take part in the planting.

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[31] De Greef, *op. cit.*, p. 64

[32] Burgt, Dictionnaire.

FIG. 19

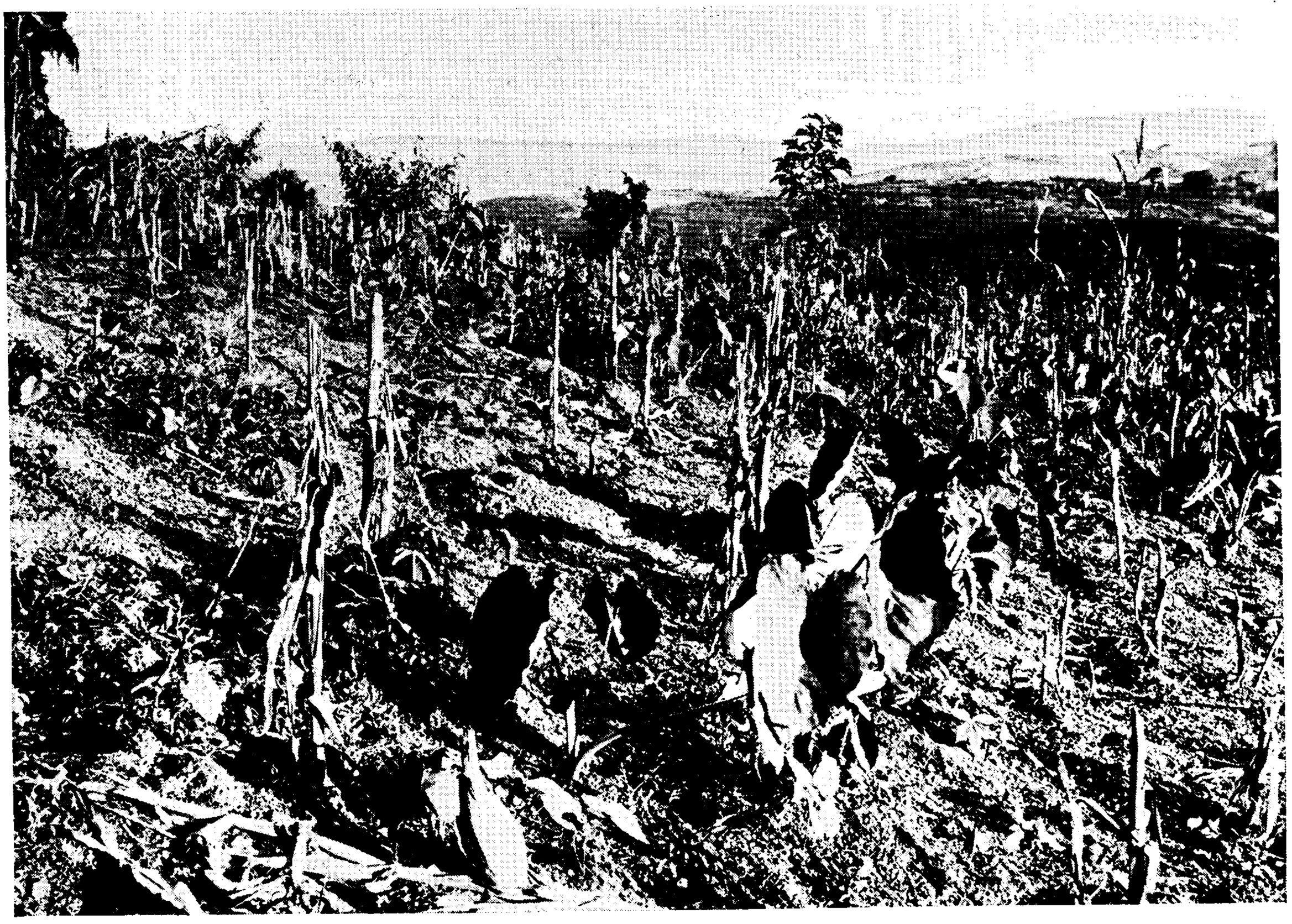

FIG. 20

FIG. 19—A field of elusine. This is one of the important grains of the highlands. It is used largely for food. The heads are relatively large, and the yield good.

FIG. 20—A field showing mixed planting. Corn and sorghum have been harvested. Colocasia is seen in the foreground. There are also young plants of cassava and beans. Since all cultivation is accomplished with the hoe the hillsides offer no disadvantages.

According to their belief[33] the king of Urundi when born holds in his hands the seeds of the different crop plants. At the proper time the king gives the signal, and all prepare the soil and plant the crops.

All land is owned by the king and is apportioned by him to the different chiefs and by them in turn to their people. These apportionments are not for a long period, and on them bribes are received. This leaves the whole matter of land tenure in an unsettled state.

FIG. 21—Stages in the preparation of cassava for food. Growing cassava is seen at the right. The roots are dug up, peeled, and placed in the earthenware jar at the left to ferment for about three days, then sundried as shown in the center. After this it is pounded in a mortar and sifted to form a fine flour. The woman is shown holding the pestle with the lower end in the mortar made from the trunk of a Ficus. In the immediate foreground are a few ears of corn.

Annual crops are planted largely at the beginning of the rainy season. The land is first worked into good tilth with the hoe, the only instrument of tillage used by the Warundi. In many places the natives have employed irrigation, using a gravity method. The systems are sometimes quite complex and are often constructed under the chief's direction by all the men of the section. In that case all are supposed to profit equally by the system. Water is not only carried about the mountain on contour lines but is carried across canyons by means of dug-out tree trunks put in place by hand.

The agriculture of the uplands is devoted in the main to the cultivation of bananas, beans and peas, eleusine, sorghum, corn, colocasia, and sweet potatoes. Beans of many kinds are grown, and to a lesser extent the cowpea.

[33] Burgt, Dictionnaire p. 21.

Beans (ikiharage) constitute one of the principal crops, probably ranking with the banana as the most important agricultural crop, important as a food and also as an export crop. Burgt[34] gives Kirundi names for 101 different varieties. Almost all of these are *Phaseolus vulgaris* of different strains. They are usually boiled in water and eaten. Cowpeas are often cooked while still somewhat green and are eaten out of the pod.

Bananas (ikitoketoke) are grown extensively over much of Urundi. They form dense plantations on almost any type of land. As a rule they do best on the richer soil and where somewhat protected from the wind. Burgt[35] states that they almost disappear on the plateau of Mugamba at 6,750 feet elevation. They grow so naturally that the Watusi pay little attention to them, and the plantations are not well kept. The bananas are seldom eaten as fresh fruit but are usually picked green, peeled, and boiled. More often they are carefully packed into a pit surrounded by fresh banana leaves. They are covered with green leaves and above this with dry leaves and sticks, which are burned off. The pit is then covered, and the bananas are allowed to ripen. They are then peeled, macerated, and the juice expressed. In order to accomplish the rather difficult feat of separating the juice from the pulp of the banana they mix the pulp with grass and squeeze out the juice, throwing the pulp and grass away. This juice, added to water and allowed to sour, constitutes the sweet beer (umutobe) drunk chiefly by women and children. Since it is a nonintoxicating beverage it is deemed unworthy of the men. If the juice is mixed with the flour of red sorghum (made from dried germinated seed) it ferments and in four or five days is ready for use and is known as beer (urwagwa).

The banana plays a very important rôle as a fiber-producing plant. It also supplies the chief wrapping material. Beans, sorghum flour, and butter are all transported in banana containers.

Sorghum (isakka) is an important crop. There are two principal kinds, a white sorghum usually marketed as threshed seed, and the double-seeded, deep red type, usually marketed in the head. The method of culture is similar to that of corn, but when nearly ripe the heads with about two feet of stalk attached are cut off and stuck down into the ground to dry. The sowing of sorghum is accompanied by one of the chief festivals of the year, when all the people come together at the call of the king to celebrate the event. Even the Batwa are admitted to the presence of the king on that day. The natives do not attempt to produce in excess of their needs, and De Greef estimates the sorghum plantings to be three fourths of a hectare (under two acres) per able-bodied man.

Eleusine (uwuro) is also a crop of importance. It was seen growing extensively in the region about N'gano N'gano. The fields blended with the natural grasslands and could not be distinguished at a distance. They were usually small, from one to a few acres. This grain is made into a flour and

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[34] *Ibid.*, p. 282.

[35] *Ibid.*, p. 64.

consumed as food and only rarely used to make beer. It is grown broadcast on soil kept level and not ridged.

Corn (ikiguri) does best in the moist valleys, where as many as three crops are grown a year. It is an important food crop. It is eaten raw by the children, is boiled on the cob or roasted, and is also ground into a flour and made into a thick mush. Corn is stored in the huts, tied up in trees in bunches with the husks on, and also stacked on bamboo fences with tips down. It is either husked in the field or the stems are cut below and above the ear to facilitate stacking on the bamboo fences. This latter method was employed on the lowlands along the lake. Corn is planted on a level soil surface, often among bananas. The seeds are usually soaked for one day before being put into the ground.

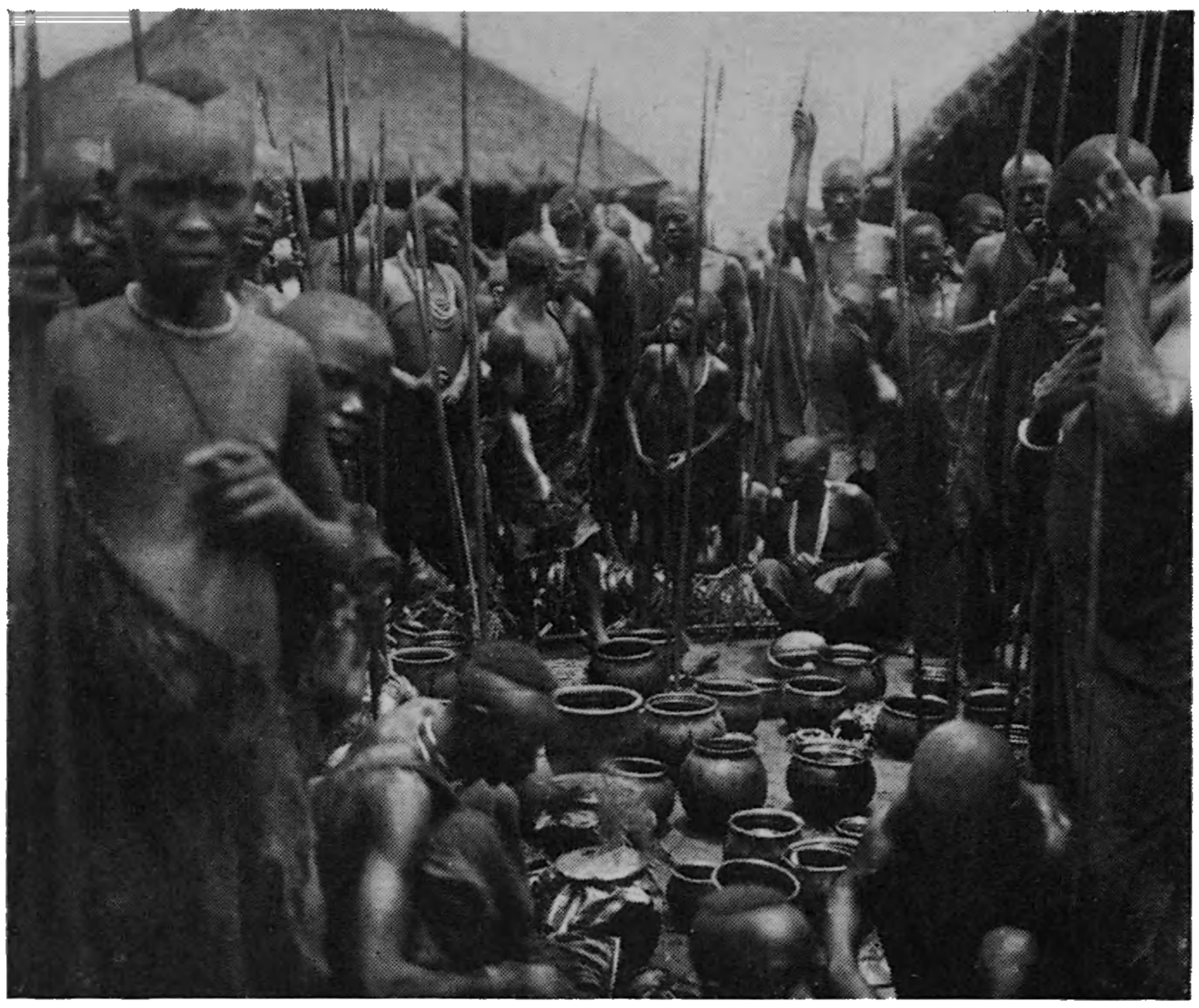

FIG. 22—Palm oil sold as an orange-colored liquid in earthern pots in the market at Nyanza. The pots are often covered with a green banana leaf tied on with banana fiber. The natives are Wahutu dressed either in "Americana," goat skins, or bark cloth. Each carries one or two long spears.

Sweet potato (ikizumbu) is planted either on a flat surface or sometimes in slightly raised beds. The roots are taken out of the ground whenever they are ready to be eaten. Colocasia (amateke) is also a relatively important root crop.

To the crops mentioned must be added pumpkin and squash, green peppers, castor bean, and various other vegetables. The leaves of beans are often eaten as spinach. Peanuts are also extensively grown.

In the region about the lake the oil palm (ikigazi) has been planted and constitutes one of the most important products. The natives here are Wahutu largely and are dependent almost entirely on agriculture. They gather the palm kernels and sell oil to the natives inland where oil cannot be produced. The export from the three chief centers of production, Nyanza, Rumonge, and Usumbura, amounts according to De Greef to about six tons per month, exclusive of the inland trade. Palm oil, like butter, is used by the natives to oil their bodies but is much more important as a cooking oil, used in the preparation of vegetables, beans, fish, and beef.

Cassava is the most important crop of the lowlands. A few plantations were seen on the uplands, but they did not look promising. The upland region is probably too cold. The stems are stuck into the ground two to three feet apart and soon grow to form a thicket four to ten feet high. At about the fourth year it is dug up, and another crop is planted. During

most of that time the plantation furnishes food, single plants being dug up or even a few roots removed.

It is eaten fresh, boiled, or baked. It is peeled, fermented for two or three days in a pot of water, dried in the sun, and boiled and eaten. After being peeled, fermented, and dried it is pounded into flour; and this flour is boiled to make a pasty loaf, one of the chief foods of the natives. In the market cassava is sold as fresh roots, fermented and dried roots, and as flour. It is also sold roasted, boiled, and as a loaf made of cassava flour. The leaves are sold as spinach. It is exported only as cassava flour.

Sugar cane is grown along the lake and here, as elsewhere in Africa, is eaten fresh.

FIG. 23—A Greek trader of the better type and his hut near the native market, Nyanza. In the photograph are shown cattle hides, palm kernels in baskets, beans, butter, and cassava flour in banana leaf containers. Wahutu traders at the left who have brought in their produce. The trader is seen in the back with his Swahili wife with the calico gown thrown over her head, and his three negro assistants.

## MARKETS

Three markets in southern Urundi were visited by the writer—one at Nyanza, one on the Macombe River, and one at N'gano N'gano (see Fig. 2).

The markets of Urundi contrasted sharply with those seen in other parts of Africa. The men do the trading. At Nyanza a few women were present, selling beer (pombe) for most part; but in the mountains no women were seen.

At N'gano N'gano the market was held on an area of bare ground with no buildings of any kind. The same was true of the market at the river. At Nyanza two shelters have been constructed for the use of the natives. Under one of these beef, fish, and goat meat are offered for sale. The meat is usually cut up with the hide still in place and sold in relatively small pieces. The goat meat was sold to a small force of *Askari* maintained by the Belgian officials. There was no definite location for the different products. The following are among the more important:

Cassava—leaves to be used as spinach; fresh roots; roots baked or boiled; roots peeled, fermented, and dried; flour made of fermented dried roots; a dough cake made of cassava flour.

Beans—dry.

Cowpea—dry peas, also boiled, nearly ripe pods.

Corn—boiled, nearly ripe, still in husk.

Sorghum—white, shelled; red, still in head.

Palm oil—sold in earthen pots, three gallons for four hellers; nuts are occasionally sold with outer pulp still intact.

Sweet potatoes—roots, fresh, both white and red types.

Salt—one of the most important imports, sold in small lots wrapped in a leaf or banana fiber.

Eggplant—green or almost ripe.

Tobacco—as a dry leaf; as dry powder, or snuff; as a liquid for use in the nose.

Beer—either by the pot or by the drink.

Bark cloth; baskets; woven bags; mats; hats (wizard foils); knives.

FIG. 24—Butter is brought to the trader in banana leaf containers. For shipment to the warmer country it is melted and poured into gasoline or oil cans. Here two natives, a Swahili (in front) and probably a Congo negro, are seen carrying empty oil cans to be used for this purpose at Nyanza.

At Nyanza palm oil was sold in a fluid state in earthenware containers, but in N'gano N'gano it was sold as a solid, care being taken to protect it from the direct rays of the sun.

In the market at Nyanza the produce was presented to the trader in the following form:

Cassava flour, corn meal, and sorghum flour in banana-leaf containers, 15–25 kilos each; beans in long containers made of leaves; palm-oil nuts in baskets or grass and banana-leaf containers; palm oil in earthen pots emptied into gasoline or oil cans and shipped; salt imported in leaf containers.

At N'gano N'gano there was much less food in proportion to other articles than at Nyanza. Fiber, both banana and raphia, and charcoal were important articles of sale in this market. Charcoal is burned in the upland forest and brought to market in containers made of grass and bound about with bast fiber. Because of the scarcity of wood, however, much of the cooking is done with sorghum or cornstalks and similar refuse.

The market is largely a place where food products are exchanged. In the part of Urundi visited by the writer the currency in standard use was the German heller. The silver franc with an Albert head would pass for 44 heller; but paper or Leopold silver or even French Republic silver would not be accepted. Most of the exchange is done with the heller and the Albert franc.

## Export

Most of the produce is consumed by the dense population, estimated at some 120 to the square mile. Cattle furnish the chief export in the form of hides. Some butter is also exported, and a little agricultural produce. De Greef[36] gives the minimum quantity of produce furnished each month by the natives at the lake ports in tons as in Table III. Exports are shipped by boat to Kigoma. From Kigoma butter and oil and hides are sent on to Dar es Salaam by rail, a distance of 780 miles. From here they are reshipped to India or Europe.

Table III—Monthly Exports from Lake Ports in Tons

| Product | Nyanza | Rumonge | Usumbura | Total |
|---|---|---|---|---|
| Cassava flour | 3.5 | 5 | 2 | 10.5 |
| Beans and peas | 3 | 3 | 20 | 26 |
| Palm oil | 1 | 5 | 0.2 | 6.2 |
| Bananas | 2 | 2 | | 4 |
| Peanuts | | | 3 | 3 |
| Corn meal | | | 2 | 2 |
| Cassava | | | 2 | 2 |
| Total | | | | 53.7 |

## Routes to Urundi

Urundi and Ruanda are not easy of access. The shortest route to Urundi is through Tanganyika Territory by rail from Dar es Salaam to Kigoma (780 miles), which requires about two days, and thence by one of the small steamers that ply irregularly between Kigoma and the lake ports of Urundi. The total time required would be about ten days. To facilitate export and development of the rich resources of Urundi and Ruanda the Germans had projected a line from Tabora, on the Central Railway, to Kaseke at the junction of the Nyavarongo (Kagera) and Ruvuvu Rivers;[37] but no steps had been taken to put this in execution before the outbreak of the war. The considerable export trade of Ruanda in hides used to go out chiefly by the Uganda railway. From Mombasa to Kisumu on Lake Victoria is 584 miles by the railway; thence one goes by boat to Bukoba and by a trek of about 200 miles across to Urundi. The time required for this route is about 30 days.

Ruanda and Urundi lie more or less in the line of a Cape-to-Cairo route.[38]

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[36] *Op. cit.*, p. 33.

[37] C. P. MacCarthy: German Plans for Railway Development in East Africa, *Geogr. Journ.*, Vol. 52, 1918, pp. 314–323.

[38] A Cape-to-Cairo time-table was worked out some time ago (*Commerce Repts.*, Mar. 7, 1918, p. 874). The *African World* (Dec. 17, 1921) announces a "Cook's Tour" from Cairo to the Cape under the guidance of Sir Alfred Sharpe, the itinerary of which is planned to go through "the very heart of the new Ruanda district of the Congo Colony" to Uvira at the northern end of Lake Tanganyika. According to Sir Alfred's schedule 36 days would be required to reach Butiaba and almost 80 to reach Lake Tanganyika. On the regular schedule for travelers on the route through Egypt, the Sudan, and Uganda, it requires connection between steamers which sail twice a month, and no very accurate schedule can be estimated.

The trip from Cairo to Lake Victoria can be made by rail, steamer, or motor with about 110 miles trek, then by boat to Bukoba and 200 miles across Urundi. This would require from 60 to 80 days. From Cape Town one can go by rail to Bukama and by steamer and rail to Albertville on Lake Tanganyika. This would require from 20 to 30 days. A partial alternative will be offered by completion of the Benguela-Kambove railroad. Another

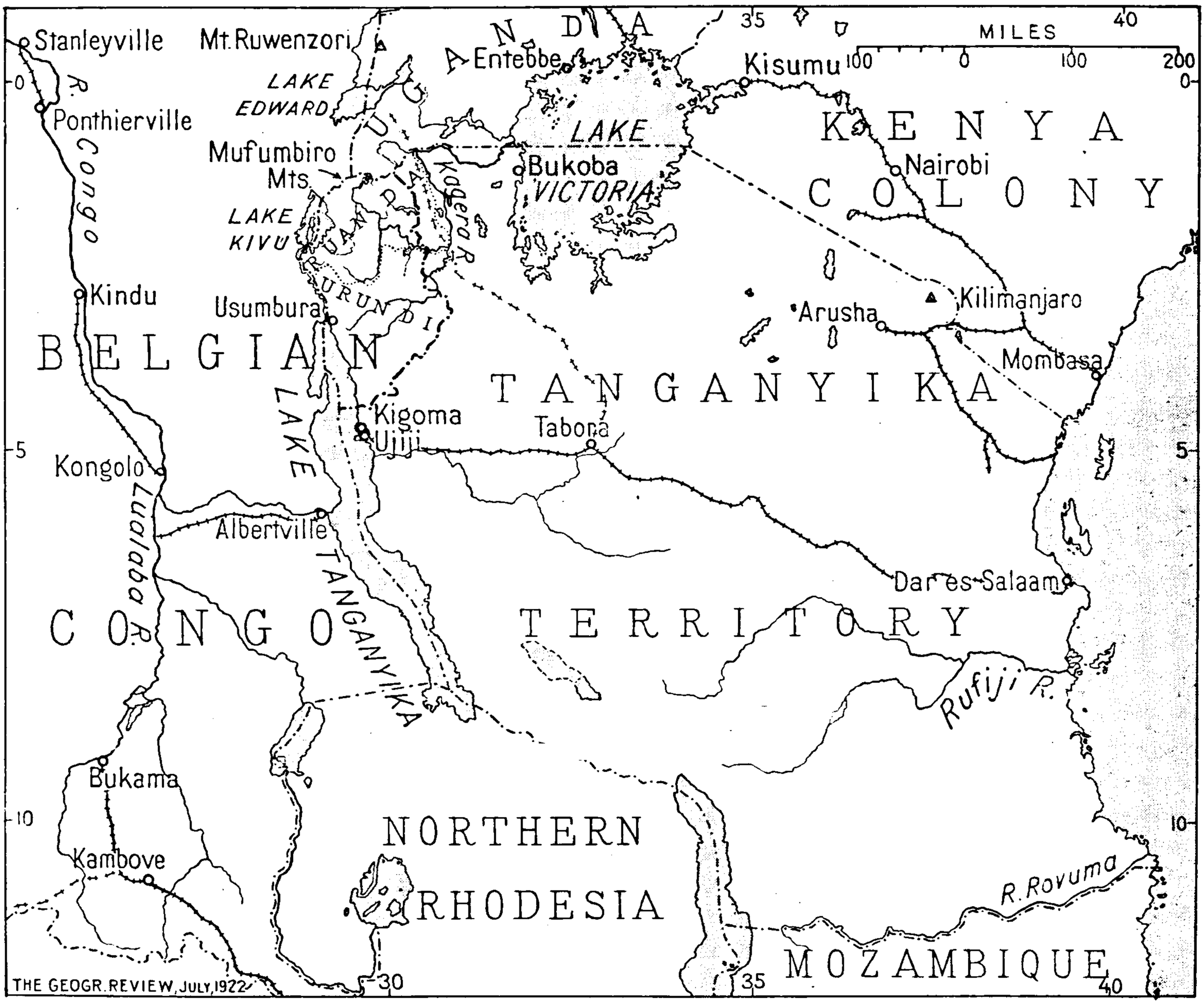


FIG. 25—Sketch map showing the situation of Ruanda and Urundi in relation to contiguous territories. The former provincial boundary is shown by a dotted line, the boundary of the area held under Belgian mandate by a heavy dot-and-dash line. Scale of map 1:15,000,000.

approach from the west is by way of the Congo, a route requiring almost as much time as the trip up the Nile but one that can be made entirely by rail and steamer.

## POLITICAL SITUATION

Because of the remoteness of Urundi and Ruanda, the character of the people and the form of government, German authority was only established slowly. "German supremacy is only recognized to a very limited extent," said Duke Adolphus of Mecklenberg in 1910.[39] At the outbreak of the war the German authorities had gained ascendancy over

[39] *Op. cit.*, p. 44.

the Sultan of Ruanda, whilst Urundi was still largely free of white domination. As a result of the war the two territories passed under the mandate of Belgium. The boundary of the mandated area, however, is not quite coincident with that of the former provinces; in particular, a strip of eastern Ruanda—a portion of the territory ruled by the native king of Ruanda—was retained by the British for construction of the Cape-to-Cairo line.[40] Politically Urundi is a feudal monarchy ruled by a monarch who possesses absolute power and is surrounded by a large court.[41] From him the chiefs receive their authorization and are apportioned their land and in turn exert absolute authority over their subjects. The first act of the Belgians was to restore and support the legitimate ruler.[42] He is a young boy about 10 or 12 years of age, and the government is in the hands of a council of three at the present time. Both the governor of the mandated territory and the Resident of Urundi are deeply interested in the welfare of the natives and are seeking to prevent their exploitation by Europeans. Care is being taken to preserve the native institutions, and it may be noted that the head tax (two francs) is much lower than in other parts of Africa. While European cereals and crops of industrial value are being introduced, the Belgian authorities are attempting primarily to foster production of the native resources and to build up trade with the natives on this basis. For instance the *chef de poste* at Nyanza was introducing better types of maize and also experimenting with cassava on the highlands and with cattle on the lake shore. To the writer it appeared that there was excellent good feeling between the Belgian officials and the natives and an attempt on both sides to co-operate for the mutual good.

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[40] On this see the report by Capt. J. E. Phillips in the article "The Cape-to-Cairo RailWay and Train Ferries," by H. Wilson Fox, *Geogr. Journ.*, Vol. 55, 1920, pp. 73–108.

[41] P. Ryckmans, Resident of Urundi, reported in *Bull. Soc. Royale de Céogr. d'Anvers*, Vol. 41, 1921, pp. 193–196.

[42] See the account of Ruanda and Urundi in *Le Mouvement Géographique*, Oct. 23, 1921, summarized from the official report of the minister of the colonies on Belgian administration in the occupied territory of former German East Africa.

# ALONG THE ANDEAN FRONT IN SOUTHEASTERN BOLIVIA

By KIRTLEY F. MATHER
Denison University

Amid cane fields and cattle pastures twenty miles east of the eastern front of the Andes lies the city of Santa Cruz de la Sierra, approximately at the geographical center of Bolivia. Its 25,000 inhabitants are cut off from contact with the outside world by almost insuperable barriers of mountains, sand-swept plain, and river swamps. On the north it is 80 miles to the head of navigation in the Amazon basin (Quatro Ojos on the Rio Pirai); on the east it is 400 miles to navigation on the Rio Paraguay (Puerto Suarez); southward it is 475 miles to the railhead at Embarcación, Argentina. In each of these directions only narrow trails or heavy oxcart roads mark the routes across the plains and through the jungle. Westward from Santa Cruz, communication with the more populous highlands of western Bolivia is precariously maintained by a 300-mile mule trail which climbs the successive ranges of the Andes to reach the railroad at Cochabamba.

From this isolated city the writer set forth in January, 1920, with two American companions and two Bolivian *arrieros* to explore the foothills of the Andes along the route which leads southward past the frontier city, Yacuiba, to Embarcación. In the comparatively short space of forty days we inspected in greater or less detail six of the mountain ranges and three of the groups of hills which occupy the transition zone between the interior plains on the east and the Andean Cordillera on the west in latitude 18° to 23° S.

## THE SANTA CRUZ PLAINS

The plains of Santa Cruz are the northwestern extension of the Gran Chaco, which occupies the entire southeastern quarter of Bolivia and continues southward into Argentina. Near Santa Cruz the altitude of this great interior plain is approximately 1,400 feet. Between the Rio Grande and Rio Pilcomayo its western margin rises to an elevation of about 2,500 feet, but still farther to the south near the Bolivian-Argentine frontier it again declines to 1,500 feet or less. The trails leading southward from Santa Cruz traverse for scores of miles the monotonously flat surface of this plain, which is occasionally crossed by shallow arroyos leading eastward from the mountain front. Near the mountains there are many low knolls and irregular rolling hills of sand, easily recognized as ancient dunes now anchored by vegetation. In places the trails pass by live dunes of glistening yellow-

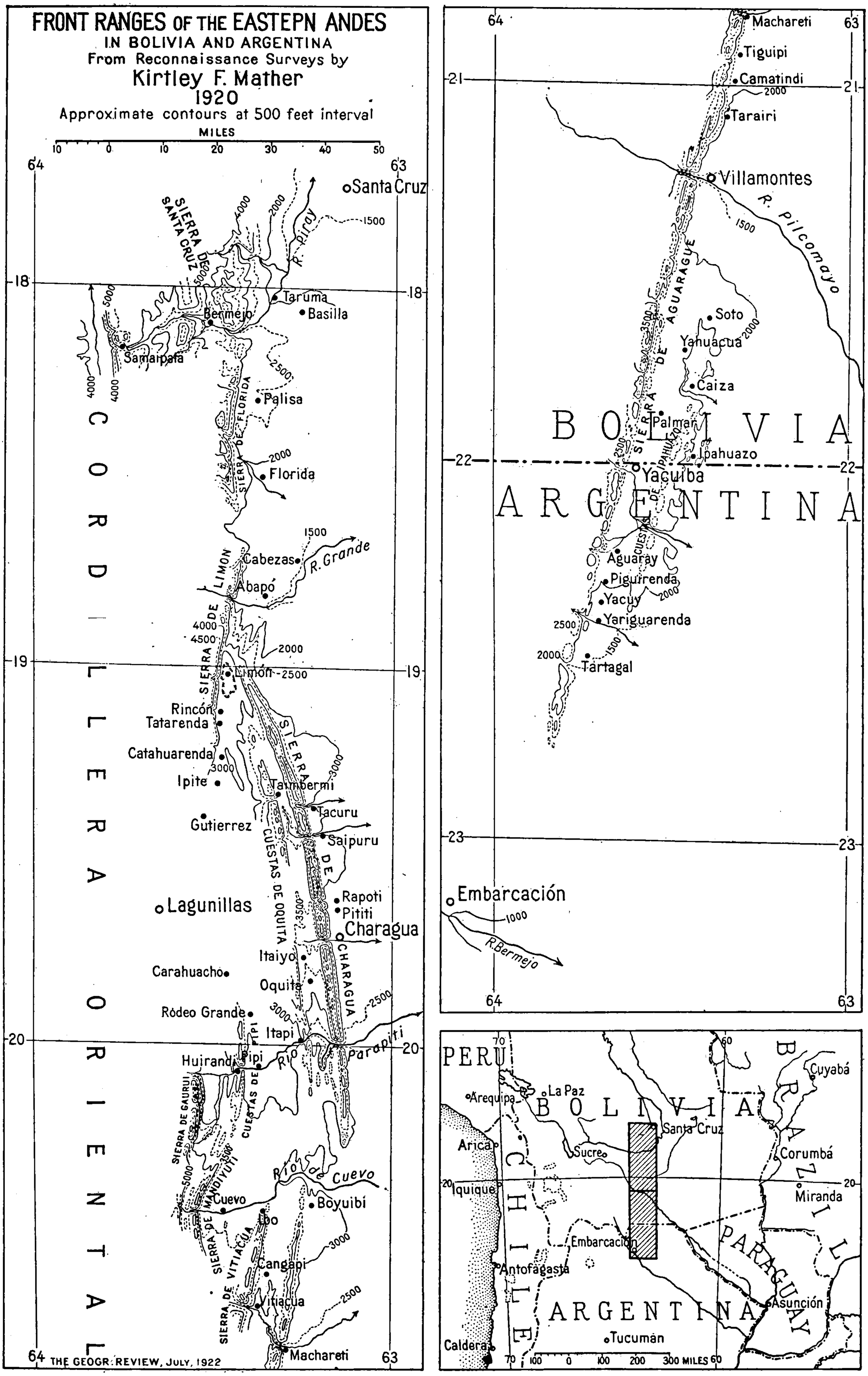


FIG. 1—Reconnaissance survey map of the front ranges of the eastern Andes between latitudes 17° 45′ S. and 22° 45′ S. Scale approximately 1:2,150,000. In the lower right corner, map showing location of the area surveyed.

white sand, restless beneath the shifting breezes of the plain. Among the sand hills during the rainy season there are numerous ponds and marshes which disappear at times of drought.

## The Sierras

The eastern front of the Andean Cordillera rises abruptly from the western side of this plain and forms a broken wall, trending approximately north and south between the 63rd and 64th meridians. The mountain ranges along this margin of the Andes are for the most part long, narrow, sharp-crested ridges which rise to altitudes of 1,500 to 2,500 feet above their surroundings. Between the successive parallel ranges there are strips of undulating lowlands, two to fifteen miles in width, with only slightly greater relief than that of the Chaco beyond the easternmost range. The crests of the ridges display a marked accordance in summit level from end to end, and there is a regular increase in the summit elevation of successive ranges from east to west. Each is bordered on one or both sides by steeply inclined hogbacks rising abruptly from the adjacent plain. Some of the ranges display precipitous fault scarps along their eastern faces.[1]

Between latitude 18° 10′ and 18° 35′ S. the front range of the Andes is the Sierra de Florida, a "fault front" range, with a thousand-foot escarpment rising boldly and abruptly from the margin of the undulating lowland which terminates at the foot of the cliff. Its topography is exceedingly rugged and forbidding. To the westward it apparently merges into the successively higher ranges toward the heart of the Cordillera. This is the most northerly fault escarpment of any prominence along the front of the Andes in central Bolivia, for the Sierras de Santa Cruz display a very different topography. These sierras lie directly west of the city of Santa Cruz and are terminated on the east by hogbacks of resistant sandstone, which dip gently downward until they disappear beneath the Santa Cruz plains. South of Mt. Cuchilla, the most prominent peak in the southern part of the Sierra de Florida, that mountain group declines rapidly in elevation and in a short distance dwindles to a line of low hills.

A few miles farther to the south, in latitude 18° 40′, another mountain range, the Sierra de Limón, comes into existence. Within a short space its summits attain as great altitudes as those of the more northerly range with which it is approximately in line. It is also a "fault front" range with a bold escarpment overlooking the low plain which stretches eastward from its foot. West of Abapó the Sierra de Limón is broken by the valley of the Rio Grande, which flows towards the east directly athwart the range; but

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[1] The orography and geology of the front ranges of the Andes south of Santa Cruz have recently been discussed by Guido Bonarelli: Tercera contribución al conocimiento geológico de los regiones petrolíferas subandinas del Norte (Provincias de Salta y Jujuy), *Anal. Minist. de Agric.: Sección Geol., Mineral. y Minería*, Vol. 15, No. 1, Direcc. Gen. de Minas, Geol. e Hidrol., Buenos Aires, 1921. See the maps of the region from latitude 19° to 26° S. and also the diagrammatic sketch of the front ranges, Plate I. The author had had no personal experience of the ground north of Charagua.

south of the river the mountains continue for more than 25 miles, nearly to latitude 19° 20′.

The Sierra de Limón is the front range of the Andes for only about half its length. The northern outposts of another range, the Sierra de Charagua, are found four or five miles east of the Limón range where it is crossed by the 19th parallel. The Charagua range continues for more than 80 miles to the south and dies out in latitude 20° 18′. It is a narrow, rugged ridge, only about four miles wide, bordered on either side by two or three series

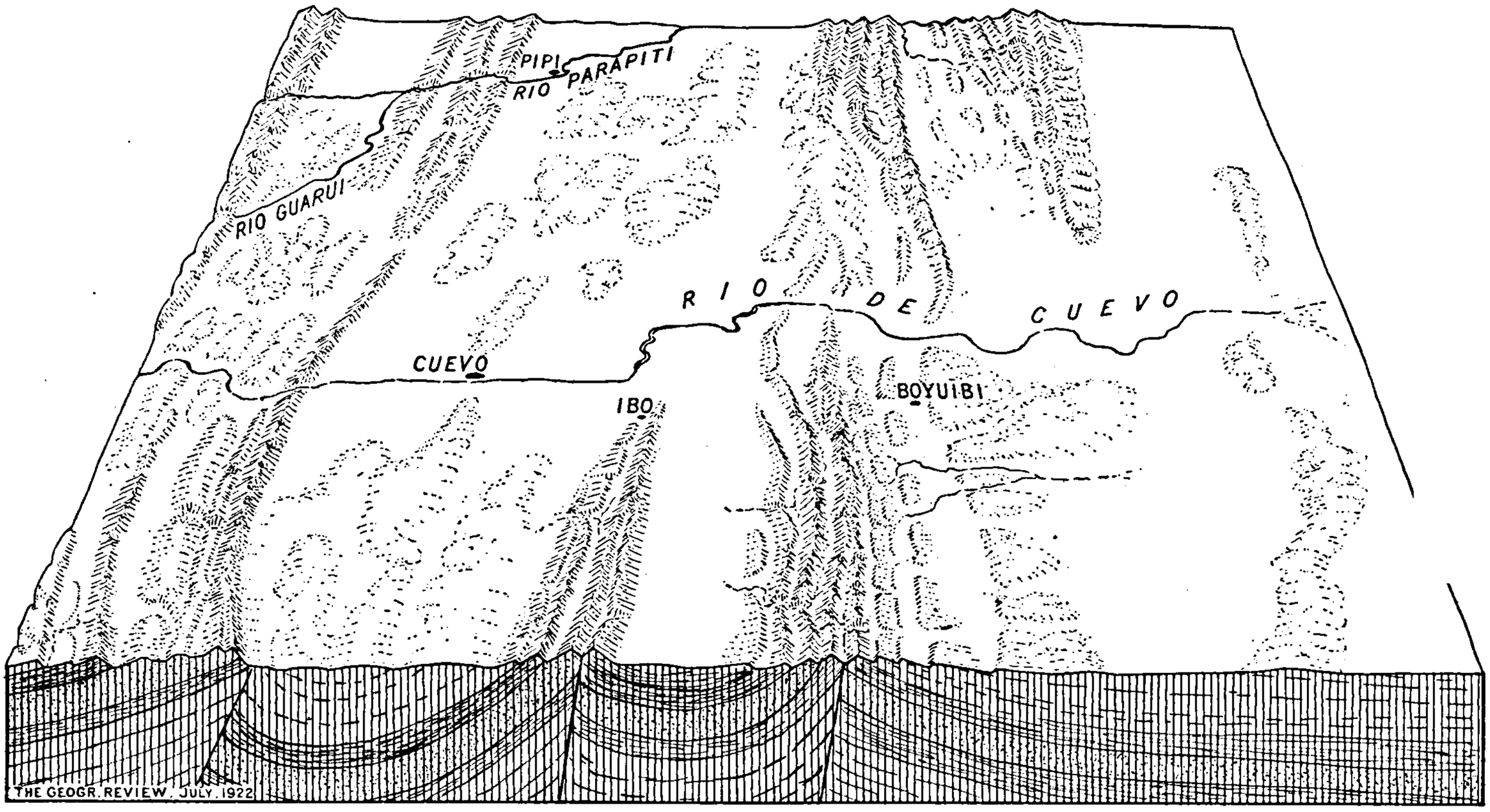


FIG. 2—Block diagram of the central section of the surveyed area (Fig. 1) compiled from data supplied by Kirtley F. Mather and other sources.

of steeply inclined hogbacks. Its higher summits attain altitudes of 4,500 to 5,000 feet above the sea, while the lowlands on either side are at elevations of 2,500 to 3,600 feet. The mountainous wall is breached at three points by narrow canyons through which the Rios Saipuru, Charagua, and Parapiti pass from the intermontane lowland west of the range to the plains which stretch eastward from its eastern foothills to form the Gran Chaco. No other front range of the entire Andes system is situated so far to the east as is this sierra. Both to the north and to the south the other front ranges are distributed *en échelon*, with each successive range a few miles farther toward the west than its predecessor in line.

A little over twenty miles west of the southern portion of the Sierra de Charagua there is another parallel but much shorter range known as the Sierra de Guarui. Among its peaks is the highest summit along the eastern margin of the Andes—an unnamed mountain whose serrate crest attains an altitude of slightly over 6,000 feet. The entire sierra is extremely rugged and youthful; its eastern margin is a bold fault scarp rising almost sheer for 1,000 or 1,200 feet above the floor of the broad lowland traversed by the Rio Guarui. This intermontane lowland, between the Sierras de Charagua

and de Guarui, is occupied by the Cuestas de Pipi and de Oquita, to which reference will be made in a succeeding paragraph.

South of latitude 20° 20′ S. the Sierra de Aguaraguë is the front range of the Andes. It begins as a line of low hills near Boyuibi, ten miles southwest of the southern end of the Sierra de Charagua, and, curving slightly westward, it extends for 170 miles, finally dying out in northern Argentina in latitude 22° 45′ S. Like the Sierra de Charagua it is a narrow, rugged, steep-sided range rising wall-like above the lowlands on either side. Unlike the more northerly range, however, its eastern face through a considerable

FIG. 3—The Santa Cruz plains stretch monotonously southward along the eastern margin of the Andean Cordillera. In the distance, beyond the plodding pack train, may be seen a group of live dunes of glistening yellow-white sand.

portion of its length is a fault scarp, although elsewhere it is bordered on the east by rank upon rank of steeply inclined hogbacks sloping away from the axis of the range. The mountain barrier is breached by two narrow canyons traversed by the Rios Vitiacua and Pilcomayo, whose sources are in the higher ranges far to the west.

West of the northern portion of the Sierra de Aguaraguë there are three parallel ranges of mountains into which my expedition penetrated. Named in order from east to west, these are the Sierra de Vitiacua, Sierra de Mandiyuti, and Sierra de Chireti. Each of these is a "fault front" range with an eastern face rising abruptly above an intermontane lowland of greater or less width.

## GROUPS OF CUESTAS

Certain of the lowland depressions between the mountain ranges mentioned in the foregoing paragraphs are occupied by groups of hills or cuestas. These ordinarily consist of several westward-sloping hogbacks. In each group the elevation of successive ridges increases from west to east, and the

easternmost hogback is abruptly terminated by a prominent fault scarp. All these hogback ridges trend north and south in approximate parallelism with one another and with the higher mountain ranges. The individual hogbacks within each group of cuestas are separated from one another by narrow steep-walled valleys, the eastern wall of which is almost everywhere a dip slope controlled by resistant sandstone beds. Each group of hogbacks is bordered on either side by rather broad, flat-floored, intermontane depressions. The most important of the cuestas examined by us are the Cuestas de Oquita and the Cuestas de Pipi, situated between the southern

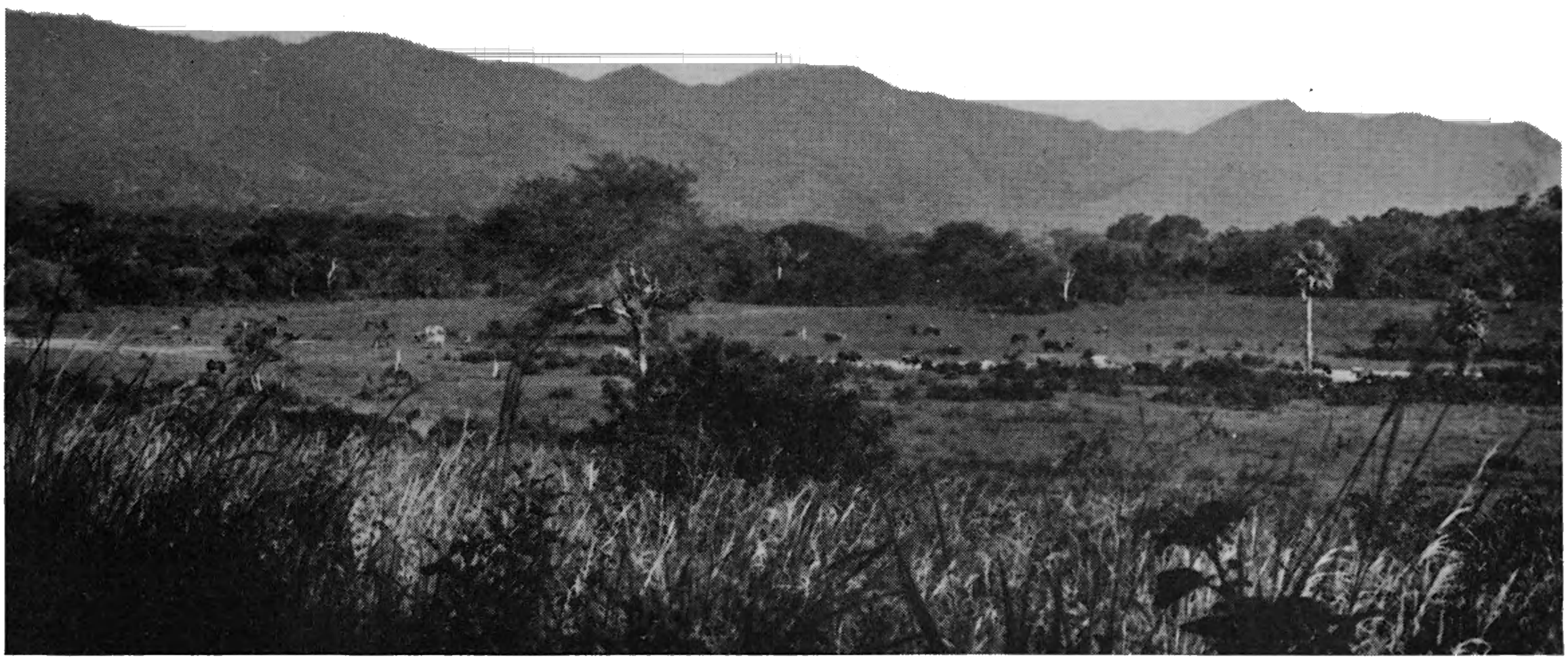

FIG. 4—The northern end of the Limón valley, with the Sierra de Limón in the distance.

quarter of the Sierra de Charagua and the Sierra de Guarui. A third group of hills is located east of the Sierra de Aguaraguë and is bisected by the 22nd parallel, which at that place is the frontier between Bolivia and Argentina. These hills, the Cuestas de Ipahuazo, are irregular rolling knolls and low hogbacks whose alignment is not nearly so perfect as that of the other cuestas.

## THE LOWLANDS

The intermontane depressions between these various sierras and cuestas are strips of undulating lowland, two to eight miles or so in width, stretching north and south for long distances. They display a relief of 50 to 250 feet. The hills which modify the smoothness of these areas are invariably irregular in distribution and display soft rounded outlines, quite in contrast to the sharp profiles of the cuestas and sierras.

The northern part of the lowland which separates the Sierra de Limón from the Sierra de Charagua is occupied in part by Lake Limón. The lake is a placid sheet of water, unruffled even by strong breezes, mirroring the mountains which rise beyond it. Its surface area is only two or three square miles, and it has no outlet. It is fed by streams and springs which rise along

the foot of the fault scarp bordering it on the west. The water has a bitter saline taste, and the strand is crusted with salt, stained blue-green from algal growths along the shore. Nothing else lives in its waters, and no birds hover over its surface. It is the Dead Sea of this part of Bolivia.

## The Rivers

The larger streams traverse this area with little apparent regard for the existing topographical features. The three largest rivers, the Rios Grande, Parapiti, and Pilcomayo, have their sources far to the west in the heart of the eastern range of the Andes system. Thence they flow in a general easterly direction, cutting through the successive ranges and cuestas in exceedingly rugged canyons, whose precipitous walls are a complete contrast to the gentler slopes of the broad, late mature valleys through which these rivers cross the intermontane lowlands. The Rio Grande is eventually tributary to the Amazon; the Rio Pilcomayo contributes its waters to the Paraguay; the Parapiti loses itself in broad marshes and swamps among the sand hills of the Chaco. If during seasons of excessive rainfall the Parapiti's volume is sufficient to permit its flow to continue across the plains, it is probable that a small percentage of its waters finally reaches the Amazon system.[2]

Other rivers, such as the Saipuru, Charagua, Cuevo, Vitiacua, and Guarui, rise within one of the inner sierras and flow thence across the intermontane depressions in broad open valleys until they reach the western side of the next range to the east. Through it they invariably make their way by means of extremely youthful gorges.

## Climate and Vegetation

In spite of its tropical location the climate of this region among the Andean foothills is genial and well-favored. It is comparable to that of New Mexico or southern Colorado. Especially after my sojourn in the Amazon lowlands north of Santa Cruz, with their oppressive heat and debilitating humidity, it was an agreeable surprise to enter the foothill country with its invigorating atmosphere and pleasing prospects. The seasons are two: a wet season extending approximately from November to April and a dry season extending from May to October. During the dry season there are occasional showers, but on the whole there is a deficiency in rainfall, so that the smaller streams disappear and only the rivers from the higher mountains may be safely counted upon as a source of water supply. At this time the weather is occasionally quite cold.[3] Ice is reported to form during the night at Palissa and elsewhere, although the altitude is

[2] This was the opinion of J. B. Minchin, who described the waters of the rainy season as probably passing through Chiquitos to the San Miguel affluent of the Guaporé ("Eastern Bolivia and the Gran Chaco," *Proc. Royal Geogr. Soc.*, Vol. 3, 1881, pp. 401–420).

[3] In the dry season at Santa Cruz the temperature may go down to 7° C. when the south wind blows. See Theodor Herzog: Vom Urwald zu den Gletschern der Kordillere, Stuttgart, 1913, p. 36.

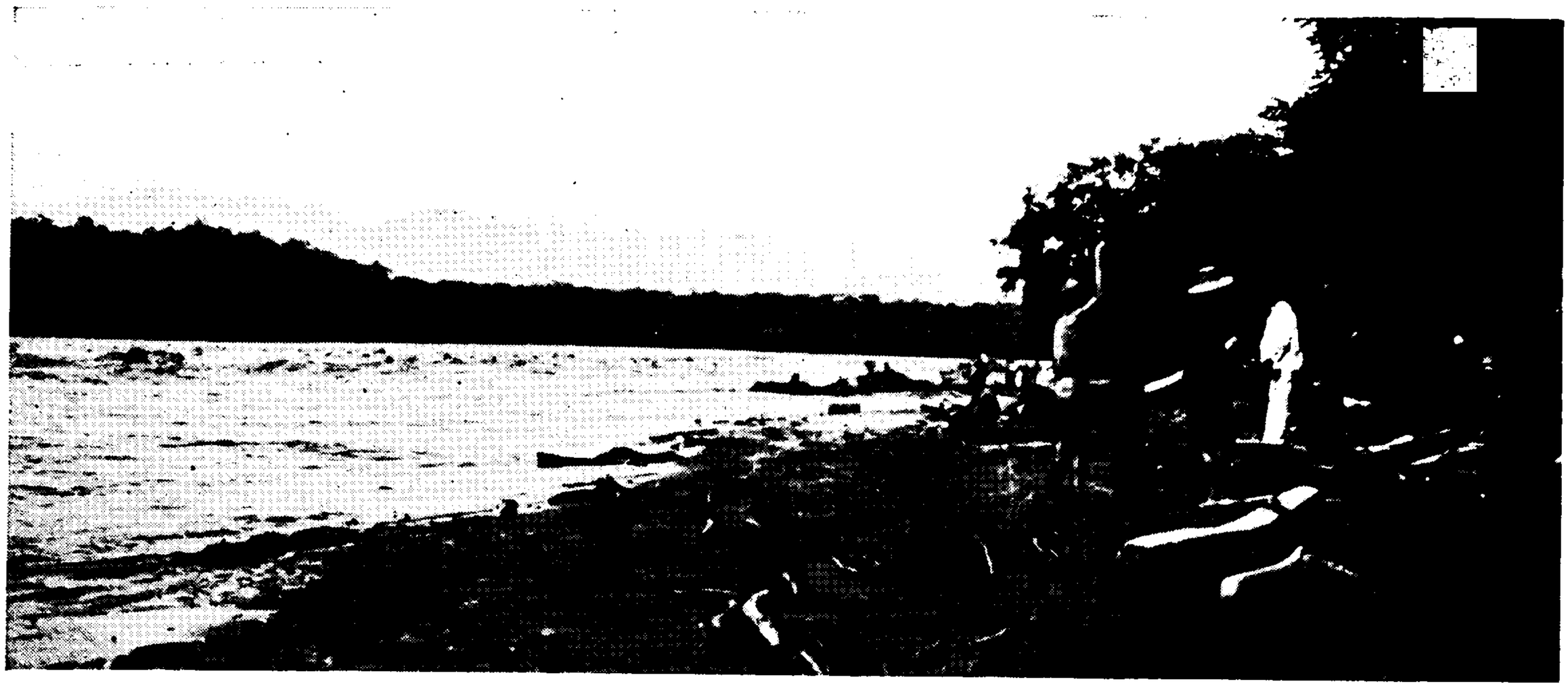

FIG. 5

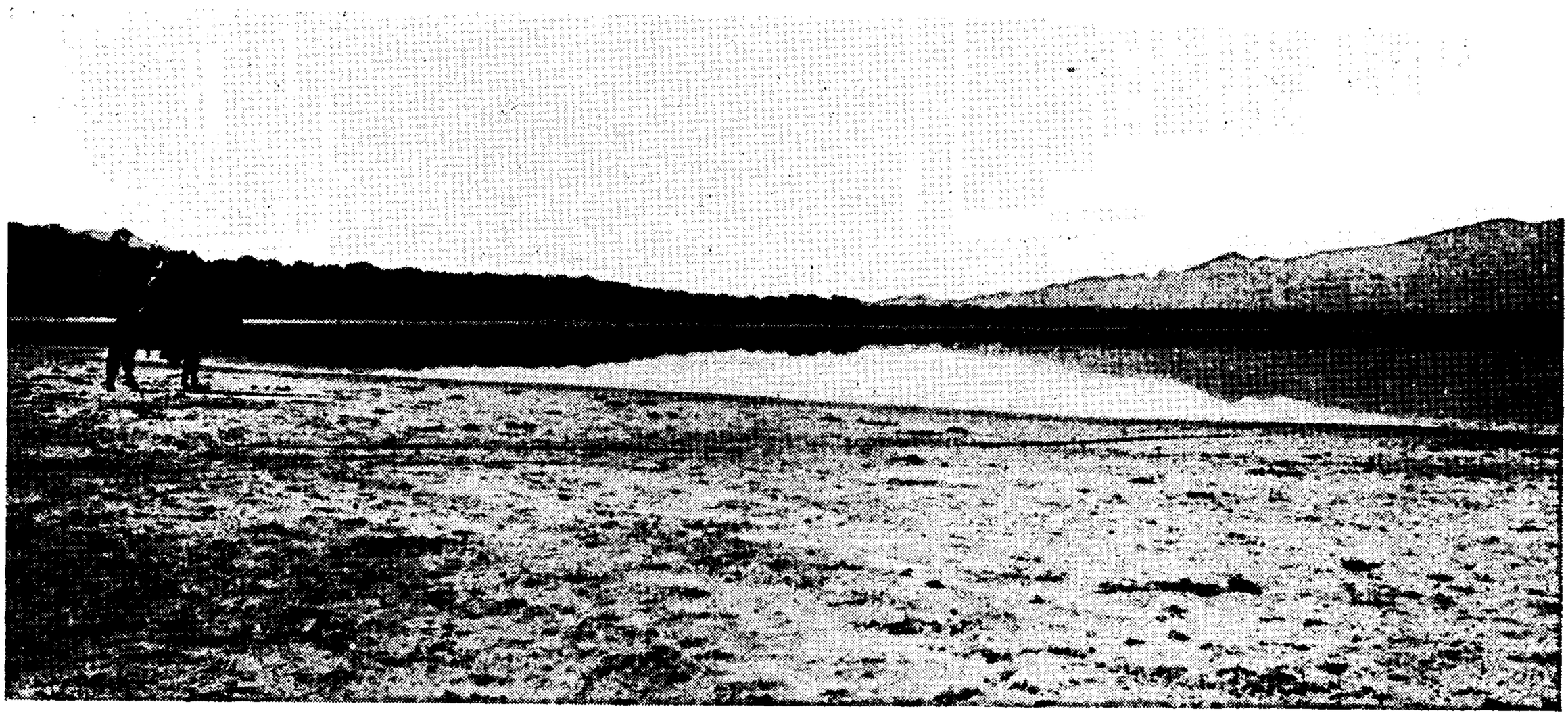

FIG. 6

FIG. 7

FIG. 5—Rio Grande at the trail crossing near Abapó. The mountains in the distance are the Sierra de Limón. At the right are the Indians with their balsa logs making ready to pilot the mules across the stream. Beyond them, another group is loading the ferryboat with luggage.

FIG. 6—Lake Limón, the "Dead Sea" of this foothill region of the eastern Andes.

FIG. 7—The Guarui valley, seen from Dr. Gareca's hacienda. Beyond the white sand flats of Rio Guarui are the back slopes of the Cuestas de Pipi.

only 2,000 feet and the location is well within the tropical zone. In September it is not unusual for the Sierra de Charagua to be white with snow. During the wet season there are frequent heavy tropical downpours, but rarely does it rain steadily for more than a few hours. This is the time of greater warmth, but even when the sun is directly overhead the heat is not oppressive because of the almost constant breezes. Nearly everywhere, except in the lower valleys of the largest streams, the nights are cool enough to make a heavy blanket a desirable part of one's camp equipment.

The healthfulness of the region in general may be inferred from the number of very old men and women to be seen in every Indian village. Troublesome insects are of course abundant here as everywhere in the tropics, but very little malaria and no yellow fever were reported to me. On the whole, climatic conditions impressed me as being favorable to permanent occupancy of this region by the white man.

The sand hills and flats along the western margin of the Santa Cruz plains support a sparse vegetation of grassy turf and low scrubby bushes, among which the thorny wild pineapple is common. Occasional clumps of tropical trees testify to the presence of unusually moist lowlands. Where the hillsides are not too steep for the lodgment of soil they are generally mantled with a luxuriant growth of verdant tropical shrubs and trees. In places this vegetation of the "rain forest" type extends beyond the foothills upon the plain, and the main trail southward from Santa Cruz passes through two such *montes*, each of which is 15 to 30 miles in width, before it reaches the Rio Grande.[4]

Farther south, in the vicinity of Charagua, Cuevo, and Yacuiba, the lowlands are generally covered with rather sparse jungle vegetation with many open grasslands eminently adapted for grazing. Figs, oranges, palms, etc., grow wild upon the hillsides; and corn, cacao, rice, wheat, yucca, and cotton are cultivated on the bottom lands.

## The Indian Tribes

The Indian inhabitants of this foothill region are known as the Chiriguanos,[5] but they apparently have no tribal organization nor unity of customs. They were first encountered by white men in December, 1609, when Franciscan missionaries explored the mountains and pushed onward to the margin of the Chaco.[6] In the seventeenth century it was reported that it

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[4] On the *monte* formation, see Theodor Herzog: Formaciones Vegetales del Este de Bolivia, *Bol. Soc. Geogr. de La Paz*, Vol. 10, 1912, pp. 159–190; on the *monte grande* see *idem:* Vom Urwald zu den Gletschern der Kordillere, p. 133.

[5] On the Chiriguanos see the works of the Franciscan missioner, Bernardino de Nino, who has lived many years among these Indians: Etnografía Chiriguana, La Paz, 1912; and *idem:* Guia al Chaco Boliviano, La Paz, 1913. The Chiriguanos (with the Chané) have also been specially studied by Erland Nordenskiold: Indianerleben, Leipzig, 1912; and *idem:* The Changes in the Material Culture of Two Indian Tribes Under the Influence of New Surroundings (Comparative Ethnographical Studies, Vol. 2), Göteborg, 1920.

[6] Nordenskiold is of the opinion that the Chiriguanos only migrated into the Andean foothill region in the early sixteenth century and that associated with them were several Portuguese ("The Guarani Invasion of the Inca Empire in the Sixteenth Century: An Historical Indian Migration," *Geogr. Rev.*, Vol. 4, 1917, pp. 103–121).

was impossible to penetrate this region because of the extraordinary numbers and unusual ferocity of its aboriginal inhabitants, and it was not until the latter half of the nineteenth century that any determined effort was made to civilize this people and to advance Bolivian settlement towards the Chaco. Between 1850 and 1890 a score of Franciscan missions were established in various localities among the foothills, and as a result of the friendly advances of the *padres* the Indians are today on terms of entirely peaceful friendship with the white men. Farther out upon the Chaco toward the east there are many scattered bands of Sirionós and Sirácuas, who are still in the stage of hostile barbarism; but not since 1892 has there been any real conflict between the Chiriguanos and the white settlers.

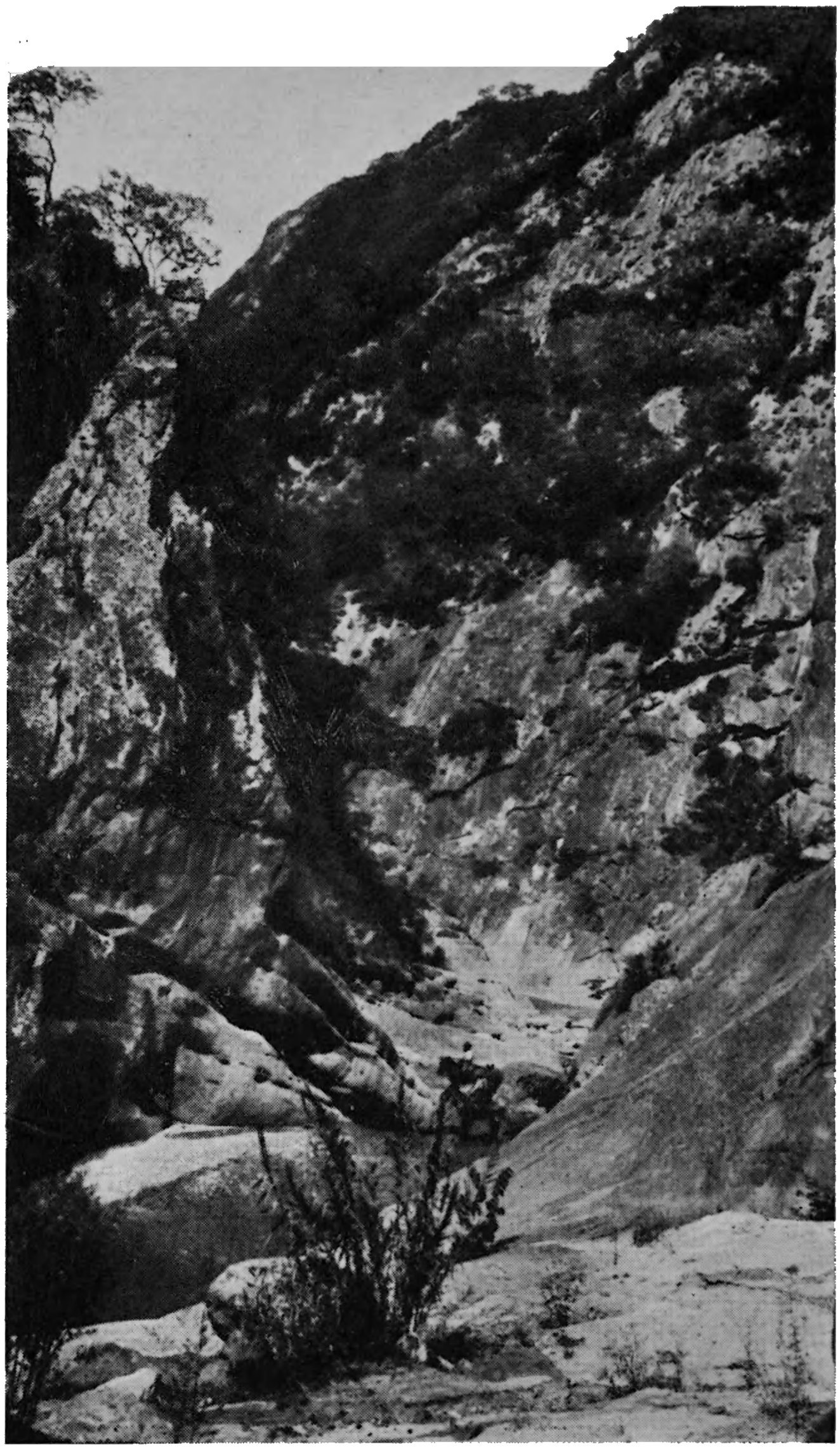

FIG. 8—The canyon of Rio Vitiacua in the Sierra de Aguaraguë.

These Indians of the lowlands are much cleaner in their personal habits than the Aymara and Quechua Indians of the better-known plateau provinces of Bolivia. Their few clothes are a striking contrast to the bulky apparel of the mountaineers, and they seem to spend a considerable portion of their time bathing in the rivers and washing their garments on the gravel bars. Soap is an exceedingly rare luxury, and the technique of the laundry is based upon the abrasive power of cobblestones between which the soiled clothes are pounded until either the dirt or the cloth disappears. Consequently ragged or much-patched garments are quite fashionable. The close contact with white people has provided an abundance of calico and gingham of foreign manufacture, but many of the Indians still prefer the homespun fabrics woven from the native cotton of the region.

For the most part we found them hospitable and friendly, quite ready to guide us through the maze of cattle trails, delighted to have us camp beneath a fig or algaroba tree in close proximity to their water holes, and

sometimes willing to sell us maize for our mules or eggs for our "table." They display the customary indolence and improvidence of savages domiciled in a land where creature comforts can be obtained with slight expenditure of energy.

According to Father Bernardino de Nino at the present time there are between 22,000 and 26,000 Indian inhabitants of this region, and practically all of them have embraced the Catholic religion as proclaimed to them by the Franciscan monks. A few of them are living as peons on the cattle ranches or estates of the Bolivian dons who have acquired a small proportion of the more fertile lands, but the great majority are distributed in villages varying in size from a half-dozen to 300 bamboo-thatched huts, which are always located close to the banks of one of the numerous streams flowing eastward from the mountains. Some of these villages are cattle stations on the larger estates, and in them there is always a Bolivian overseer—one of the lesser cogs in the feudal system which dominates this frontier of civilization. Other villages are in close proximity to Franciscan missions.

Many of the Chiriguanos whom we met south of Cuevo and Boyuibi were decorated with daubs of brilliant red paint, splashed liberally upon their faces and bodies. Some of them had also large green buttons fastened into holes in their lower lips. Most of them wore necklaces of beads, teeth, etc., in which the tin Bolivian ten-centavo coin generally occupied the place of honor. Nowhere did we see the brilliant-hued baubles made of toucan and macaw feathers that are prized so highly by the Indians of the jungles of northern Bolivia. Especially north of the Parapiti I was impressed by the musical predilections of the natives. Nearly always the men carry reed flutes with them wherever they go, and they are constantly playing weird melodies as they ramble along the trail.

## The Franciscan Missions

The missions of Santa Rosa and Tareiri are the two most imposing of the many seen between Santa Cruz and Yacuiba. Santa Rosa crowns a low hill in the lowland, three miles south of Cuevo. Over its main doorway are the words, "Euntes docete omnes gentes, S. Matth. xxviii, Mision de S. Rosa, 1887." The Mission at Tareiri is much older, having been founded in 1854, and its walls have more than once served as bulwarks behind which the doughty padres repulsed the onslaught of hostile savages. Each of the missions is surrounded by a considerable village, and from each the padres make occasional pilgrimages to the outlying settlements to heal the sick and collect the gifts and offerings of their parishioners.

It is the purpose of the Franciscans to gather into their schools all of the Indian children and, although the padres are fluent in the native dialects, instruction in the schools is in Spanish. Thus the Indians are gradually being weaned away from their ancestral tongues. To the traveler in these lands this phase of mission work is obviously advantageous, for among the

youngsters in nearly every community there will generally be at least one who is delighted to act as interpreter for him.

Each of the missions has its own agricultural establishment with vineyards, maize fields, rice paddies, etc., where the villagers labor under the direction of the padres. All of the inhabitants of the villages established by the missionaries are in a state of practical serfdom, and in each locality the missionary is the benevolent monarch of all he surveys.

FIG. 9—The Franciscan mission of Santa Rosa, three miles south of Cuevo. In the distance at the right is the Sierra de Mandiyuti. The topography is typical of the intermontane lowlands.

In strange juxtaposition in one of the chambers behind the altar of the Santa Rosa church there is a well-stocked dispensary and a miscellaneous collection of plaster saints awaiting each its own *fiesta* day, when it will be gayly decorated and carried in the van of a solemn procession winding down from the chapel and through the village streets. In spite of the great amount of good which the padres are doing with their schools and medicines, it is disappointingly true that they are also fostering the spirit of ignorant superstition and blind idolatry so easily aroused in primitive minds. The pomp and ceremony of the *fiesta* processions and religious services doubtless make a strong appeal to the Indians, and with the aid of an occasional "miracle" the friars easily maintain their position of limitless autocratic power in the community.

## THE TOWNS

Of the score of Bolivian settlements large and small through which we passed on the journey from Santa Cruz to Yacuiba, the towns of Charagua and Cuevo are easily the most progressive.

Charagua is a village of something over a hundred tile-roofed adobe houses close-huddled in a compact group with the inevitable plaza at the center. Several good stores, where bread, chocolate, sugar, rice, and cloth can be purchased, face upon the plaza. At the time of my visit, February, 1920, the report was current that one of the large English trading concerns of northern Argentina was soon to open a post at that place, but no foreigners had as yet established themselves in the community. In the center of the plaza is a well, dug to a depth of 60 feet, which renders it unnecessary for the Charaguans to make the daily trip to the river for their supply of water, as do other villagers.

Cuevo is a similar village a few miles east of the Sierra de Mandiyuti. The surrounding region is excellent cattle country, and in the town the most progressive family is one which had migrated thence from France just after the war and is running a small tannery as an adjunct to their little store. Villamontes, on the north bank of the Pilcomayo River, is veritably a German settlement. One of the more powerful South American mercantile houses owns several hundred square miles of cattle lands along the Pilcomayo River, and their ranch headquarters and main trading post are located here. Their transportation route for export of hides and import of trading stock is to the southward past Yacuiba to the Argentine railroad at Embarcación.

Yacuiba is a much larger village, the capital of the province of the Gran Chaco. It was originally established on what was supposed to be the frontier between Argentina and Bolivia, but when that frontier was surveyed by the international commission it was found that the boundary line was a mile and a half north of the town. In spite of this fact the Argentine Republic has left the Bolivian government in complete charge of the village and its surroundings. There is even an Argentine consulate in the town. Traveling southward one does not encounter the Argentine customs officials until several miles south of Yacuiba, well within Argentine territory. Even beyond that point, at least as far south as Tartagal, the upper classes among the scanty population are dominantly Bolivian rather than Argentine. In Yacuiba there are branch houses of two or three German and English trading companies which at present have a secure hold on the trade of northern Argentina, and there is also a sprinkling of Spanish, Italian, and French immigrants.

The Bolivian government maintains a monthly mail service between these various towns as far north as Saipuru. From Boyuibi southward in front of the Sierra de Aguaraguë there is a telegraph line which connects the various scattered towns. Unfortunately the wire is out of commission much of the time, but when it is working, it is possible to send messages from these isolated hamlets to any place in the world. Four miles north of Yacuiba there is a powerful wireless station maintained by the Bolivian government in order to keep the soldiers along the frontier in touch with the authorities at La Paz.

## Trails and Roads

Throughout the entire area traversed by us in our explorations among the foothills there are no improved roads. Cattle paths lead everywhere, and all the Indian and Bolivian settlements are connected by a network of fairly good trails. In very few localities is it necessary to spend much energy cutting paths through the jungle, as there is ordinarily plenty of open country through which the trails may easily go. Near the larger towns the trails have been used by oxcarts, which traverse the open plain

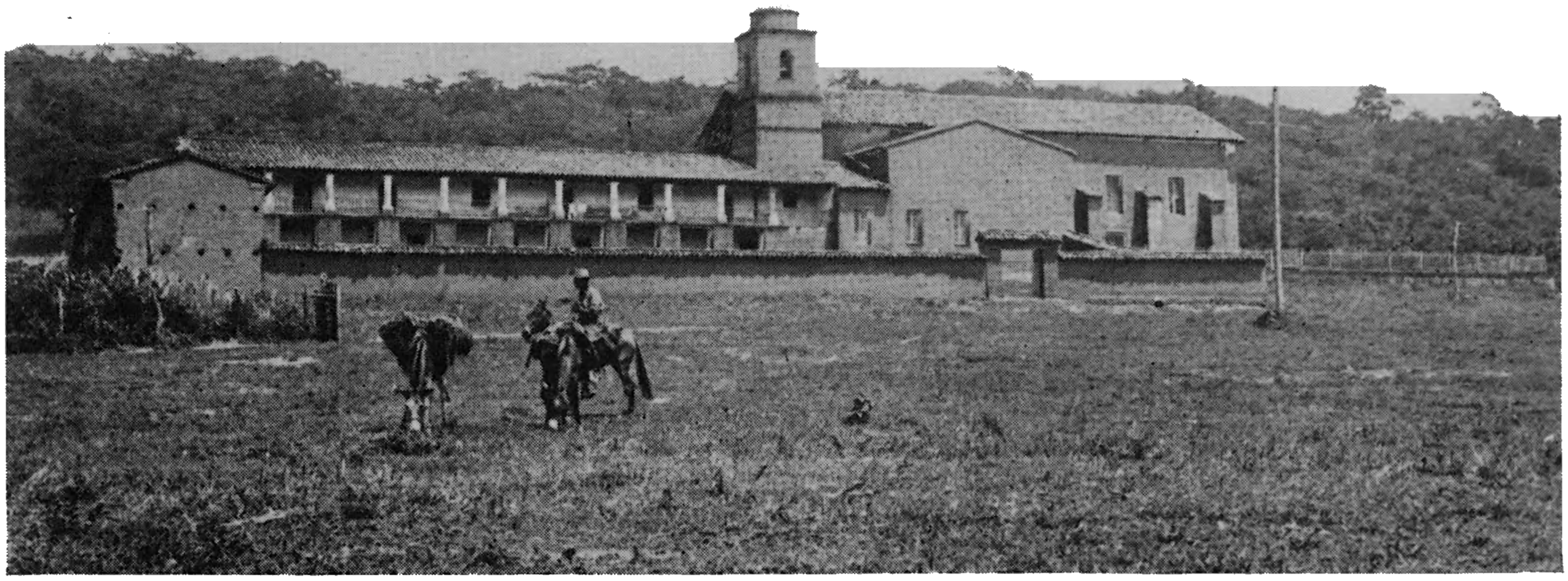

Fig. 10—The Franciscan mission at Tareiri, a few miles east of the Sierra de Aguaraguë. This is one of the first of the many missions of this region of Bolivia and was established in 1854.

with nearly as great freedom as the saddle animals. The numerous unbridged arroyos and small stream courses are, however, such barriers to wheeled vehicles that carts seldom go more than a score of miles from the place where they were made.

The two-wheeled carts are rough-hewn from the native woods, cedar and mahogany being commonly used. The huge wheels, four to six feet in diameter, are fixed on wooden axles. Grease is practically an unknown quantity so far as these carts are concerned, and hence their slow progress is accompanied by a constant chorus of squeaks and groans.

In 1913 the arroyos crossed by the trail leading northward from Embarcación past Yacuiba to Charagua and Cuevo were bridged to make possible the transportation of oil-well machinery to drilling sites near the two last-named towns. Since then most of these bridges have dropped to pieces, and this road is now practicable for wheeled vehicles only as far north as the Pilcomayo River. From Soto southward the road is still in fairly good condition, and in and near the little towns along the way I noticed a few four-wheeled wagons with metal tires and hubs of foreign

manufacture. Improved methods of transportation are gradually advancing northward from the Argentine into this part of Bolivia.

For the traveler on horseback or with mule train the only difficult parts of the journey from Santa Cruz to Embarcación are the river crossings. Many of the streams cannot be forded in time of flood, but except for the danger of quicksand even the Parapiti is passable at any time during the dry season and at frequent intervals during the wet. The Rio Grande and the Rio Pilcomayo, however, are seldom low enough to be forded with safety. At the more important trail crossings there are little settlements of Indians who make it their business to assist in the passage of the river. Luggage, saddles, and all equipage are ferried across in crude flat-bottomed boats which are carried a half mile or so downstream before the frantic efforts of the Indian oarsmen bring them to the farther bank. Mules, horses, and cattle are forced to swim the river under the guidance of the band of Indians, each of whom is provided with a log float of balsa wood without which none ever ventures far from shore in such turbulent rivers as these.

## Agricultural Development

This is preëminently a cattle country. The sparse vegetation of the lowlands resulting from the somewhat meager rainfall is nevertheless sufficient for the sustenance of vast herds of cattle. What little utilization has been made of the agricultural resources of the region is chiefly based upon the nutritious grasslands. There are numerous cattle ranches in the vicinity of each of the larger Bolivian settlements, such as Saipuru, Charagua, Cuevo, Camatindi, Villamontes, Caiza, Palmar, and Yacuiba. At nearly all of these there is a considerable acreage of corn and sugar cane under cultivation. Each ranch house boasts a large wooden cane press, and many *estancieros* have crude stills where alcohol is made from the cane syrup. Apparently the only important exports are hides and alcohol, which may be transported on mule back, and cattle, which are driven southward to the markets of northern Argentina. In the vicinity of Yacuiba the cows are milked once a day for a period of two or three months, and cheese is manufactured as the only nonperishable milk product suitable for export from an iceless region, into which the condensery and its tin cans have not yet come.

There are a few large estates, each covering 40 to 200 square miles, scattered among the hills at some distance from the towns. One of these estates, occupying 70 square leagues along the Parapiti River west of the Charagua range, is owned by a Bolivian, who lives at Pipi in a bamboo-and-mud house scarcely distinguishable from the Indian shacks. Another far more pretentious estate is the *hacienda* of Dr. Gareca in the Guarui valley between the Sierra de Guarui and the Cuestas de Pipi. His *finca* is a large frame building in which many of the windows are glazed; there is every evidence of a desire to make the place clean and comfortable for the owner

FIG. 11

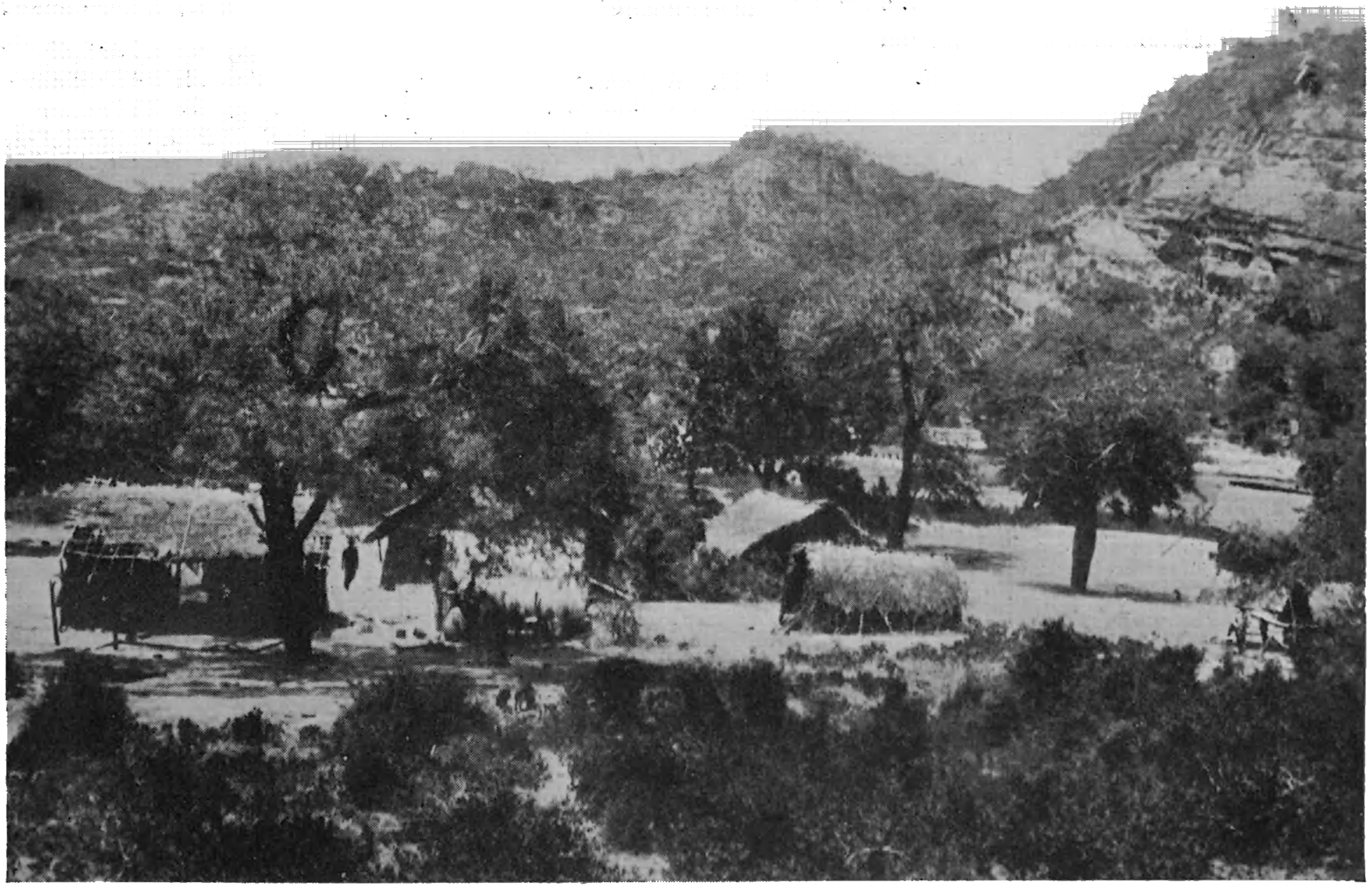

FIG. 12

FIG. 11—The Indian (Chiriguano) village at the mission of Tareiri.

FIG. 12—An Indian village, Itapi, typical of the settlements at a distance from the missions of this foothills region.

and his family. Most of these large estates are managed by *administradors*, who seldom display much capacity for thrift or industry; the owners live in Buenos Aires or Paris. It is quite evident that the absentee landowner system is utterly failing to make the most of the opportunities offered by this land.

## Future Possibilities

Entirely apart from the probable mineral wealth, such, for example, as that represented by petroleum, of which indications have been obtained at many points in this portion of the Andean front,[7] it is plainly evident that this is a land of rich promise. The development of its agricultural resources has hardly begun. The excellent kitchen gardens and vineyards maintained by the Franciscan padres at many of the missions are proof of the possibility of successful cultivation of a great variety of farm and garden products. The relations between the streams heading in the rain-drenched mountains farther west, the dam and reservoir sites in the canyons through the various sierras, and the wide-spreading lowlands between and beyond the parallel ranges are ideal for the construction of irrigation systems to supply moisture for the thirsty soil where such is needed.

In spite of the tropical location the climatic conditions seem entirely favorable to the settlement of the region by white men. Its backwardness appears to be mainly a result of its remoteness from the established centers of civilization. This remoteness, however, cannot delay much longer the settlement of this land by energetic and ambitious pioneers. A preliminary survey for a railroad to run from Embarcación to Santa Cruz by way of Yacuiba, Villamontes, and Charagua has already been completed. The Bolivian government, however, is opposed to the construction of such a railroad until after the completion of the Cochabamba-Santa Cruz Railroad, also *en proyecto*, because of the fear of increasing the already close co-ordination of eastern Bolivia with Argentina before the contacts of eastern Bolivia with western Bolivia are perfected. Both these railroad projects, however, will probably be consummated within ten or fifteen years.

In northern Argentina, between Embarcación and Tucumán, the land is already fairly well populated and is occupied by hundreds of profitable estates from which wheat, sugar, and corn are today being exported in large amounts. The contrast between the modern homes and thrifty appearance of the northern Argentine towns and *haciendas*, on the one hand, and the squalid huts and vast vacant spaces of eastern Bolivia, on the other, is an object lesson which cannot but direct attention toward the possibilities of the more northern area. The frontier of civilization is creeping northward along the mountain front; in the next few years one may confidently expect great changes in this pioneer land.

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[7] See Bonarelli, *op. cit.*, and bibliography contained therein.

# THE DISTRIBUTION OF FUTURE WHITE SETTLEMENT*

## A WORLD SURVEY BASED ON PHYSIOGRAPHIC DATA

By GRIFFITH TAYLOR
University of Sydney

With the passing of many purely artificial military and political boundaries we may look with more certainty to a time when the unrestrained economic resources of a region shall be the controlling factors in determining its prosperity and the density of its population.

For the past ten years the writer has been engaged on economic physiographic research in regard to the continent where such problems are presented in their simplest form. In Australia we are free from the presence of an alien racial element, and our climatic controls are relatively simple and are not confused by great topographic variation. At the same time a large range of climates, from the hottest tropical in the northwest to the cool temperate of Tasmania, affords a broad basis for comparative research.

In papers recently published[1] I have determined for Australia the temperature and humidity controls governing white settlement and the temperature and rainfall controls determining the economic limits of the main industries. On these bases I constructed a map showing how the future settlement of tropical Australia might reasonably be expected to be distributed.

The present paper is an attempt to carry out a similar investigation for the world as a whole and so to deduce the economic status of the continents including Australia. I have confined my study to the so-called white race, i.e. Europeans and their descendants, because data as to its climatic controls are available. This is not the case, so far as I am aware, with regard to the Mongolian or Negro races.[2] The white race has no opportunity or wish to supplant the yellow or black races in a broad belt of the Old World extending from Liberia to Japan, a limitation indicated by the boundaries in the map of future populations (Fig. 8). I have, however, thought it of

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* I have to thank Professor Skeats for reading the manuscript and making many helpful criticisms.

[1] Griffith Taylor: The Control of Settlement by Humidity and Temperature, *Commonwealth Bur. of Meteorol. Bull., No. 14*, Melbourne, 1916.

*Idem:* Geographical Factors Controlling the Settlement of Tropical Australia, *Queensland Geogr. Journ.*, Vols. 32–33, 1918, pp. 1–67; abridged in *Geogr. Rev.*, Vol. 8, 1919, pp. 84–115. See especially the map (Fig. 23 in the abridged version) of potentialities of settlement in tropical Australia.

[2] I use the terms "White" race and "Mongolian" race in their generally accepted usage. There is, however, no doubt in my mind that the *Alpine* Europeans are closely akin to many so-called Mongolian, Indonesian, Polynesian, and Amerind peoples; while the other "White" races have millions of close ethnical relations in America, Malaya, etc. I have developed this thesis of migration zones in "Climatic Cycles and Evolution," *Geogr. Rev.*, Vol. 8, 1919, pp. 289–328, and "The Evolution and Distribution of Race, Culture, and Language," *ibid.*, Vol. 11, 1921, pp. 54–119.

interest to carry my investigation into these debarred regions, though here the results are outside the realm of practical geography.

The problem falls into three divisions. First, it is necessary to decide on the major controls which determine white settlement. Secondly, we must assign relative values to these several controls. Thirdly, we must classify the many diverse regions of the world, so that each unit shall be capable of quantitative consideration in terms of the controls determined upon.

My method has been as follows. I have subdivided the continents into economic regions. Each of these regions is tabulated in terms of what seem, in the writer's opinion, to be the four dominant controls (temperature, rainfall, location, and coal reserves). From these a quadrangular graph—the *econograph*—is constructed for each region. The area of this graph is found to represent approximately the habitability of the region concerned. Lines of equal habitability (isoikētes) are drawn on a map of the world. Using the present European populations as a criterion of reasonable saturation, it is shown that these isoiketes may be translated into isopleths of future population.

The map indicates that white settlement will tend to congregate around five world centers, or clusters of cities of a type which Geddes has named "conurbations." These are near London, Chicago, Sydney, Durban, and Buenos Aires. Of these the center in the United States will probably be the largest.

## Economic Regions

In an investigation which contains so many variable factors the personal equation of the writer is bound to enter to some extent. The only way to counteract this is carefully to classify the regions involved and then to allot them economic values according to a fixed scale.

The economic regions which I have used, numbering 74 in all, are shown in Figure 1. These are much the same as Herbertson's natural regions[3] in the temperate zones. I have inserted the boundary between Europe and Asia; and, as the European plain varies so greatly in its economic resources, I have divided it into three units, approximately according to temperature. In Asia the Siberian belt is also separated into a western lowland and an eastern highland portion. The northern and southern halves of China differ greatly in resources and are subdivided. My studies of tropical Australia have led me to distinguish other types in the torrid zone, and it is here that I have modified Herbertson's regions most largely. Diverse topographies and differences in the rainfall types determined the subdivisions. The Saharan and Australian arid regions are divided in accord with the line separating the summer from the winter rain regions. This is, however, not of great economic importance. In North America the modifications are not marked. I have extended the Tundra region to the south; and on the

[3] A. J. Herbertson: The Major Natural Regions: An Essay in Systematic Geography, *Geogr. Journ.*, Vol. 25, 1905, pp. 300–312. The classification is carried further in "Oxford Wall Maps, Natural Regions," 1912.

east I have recognized three other regions, Eastern Canada and the Northeastern and Southeastern States.

The areas of these regions are given in the first column of Table IV. They were determined by planimeter and are approximate only. I have named the region in accord with the chief country or province included, but the economic and political boundaries rarely coincide.

## Temperature Control

A glance at an ethnographic map of the world will show that temperature is the primary control in determining the distribution of the white race; but the optimum temperature and the upper and lower limits require considerable investigation. My own investigations have shown that a wet bulb temperature of 50° and a relative humidity of 75 per cent are near the optimum for the white race.[4] Unfortunately few countries publish wet bulb data, but the usual dry bulb reading under these conditions is close to 53° F. Huntington,[5] by an entirely different method, arrived at 60° F. as the best temperature for strenuous physical work and 40° for mental work. The upper temperature limit for fairly close white settlement seems to be about 70° F. (average annual temperature) or a little over. The chief "white" regions where such conditions obtain are in Brazil and northern Queensland. The chief control of the lower limit is economic rather than hygienic. The polar boundary of agriculture is not far from the annual isotherm of 30° F. We may therefore adopt these temperatures, 30°, 53°, and 70°, as critical values in our investigation.

Any world-wide study of temperature is greatly handicapped by the fact that published maps almost without exception show isotherms *reduced to sea level*.[6] This may be essential for forecasting, etc., but it makes the map almost useless for the economic geographer. Obviously it is not of much use to know that Tibet would have a temperature of 70° if it were at sea level, when actually the thermometer is usually below freezing!

In Figure 2 I give an approximation to the *actual* average annual temperature chart of the world. It is based on Buchan's map in Bartholomew's Meteorological Atlas, but is modified in accord with data in Hann's Handbuch der Klimatologie and elsewhere. The factor of 10° F. decrease with each 3,000 feet elevation has been used in calculating the temperatures. Little alteration is necessary in Europe and Australia, but Africa and especially Asia show striking convolutions in the isotherms.

The usual maps tend to give a wrong impression of inland Asia. We see that vast areas are too cold to have any value as areas of close settlement. On the other hand, there is a corresponding improvement in Africa, espe-

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[4] Griffith Taylor: The Control of Settlement by Humidity and Temperature (discussed in the *Geogr. Rev.*, Vol. 4, 1917, pp. 401–403, and Vol. 5, 1918, p. 86).

[5] Ellsworth Huntington: Civilization and Climate, New Haven, 1915.

[6] A. J. Herbertson: Thermal Regions of the World, Oxford Wall Maps, 1909, shows mean actual temperatures (isotherms 32°, 50°, 68° F.) for January and July.

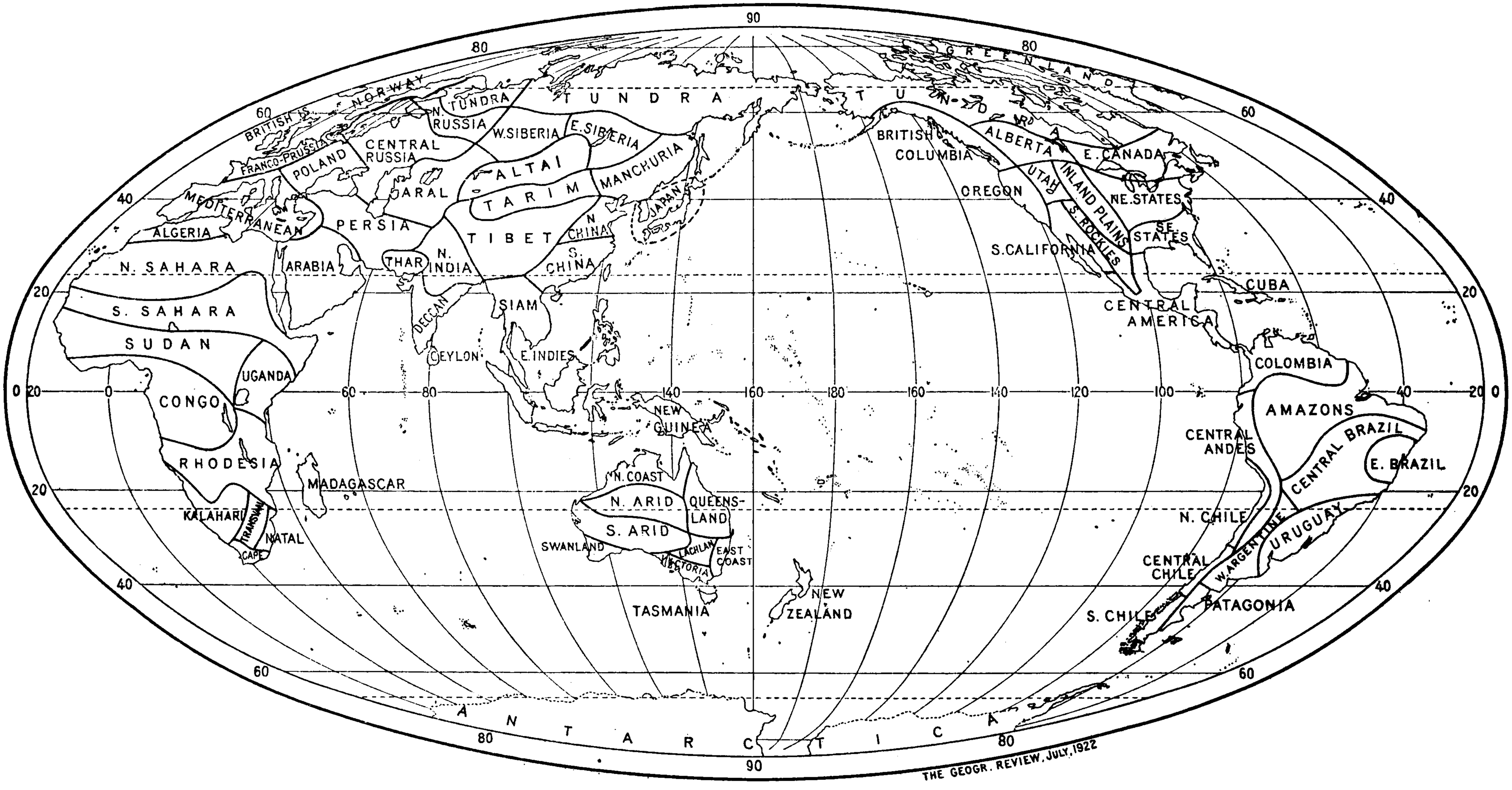


FIG. 1—Major economic regions of the world (boundaries partly after Herbertson). For the area and economic factors of the regions see Table IV.

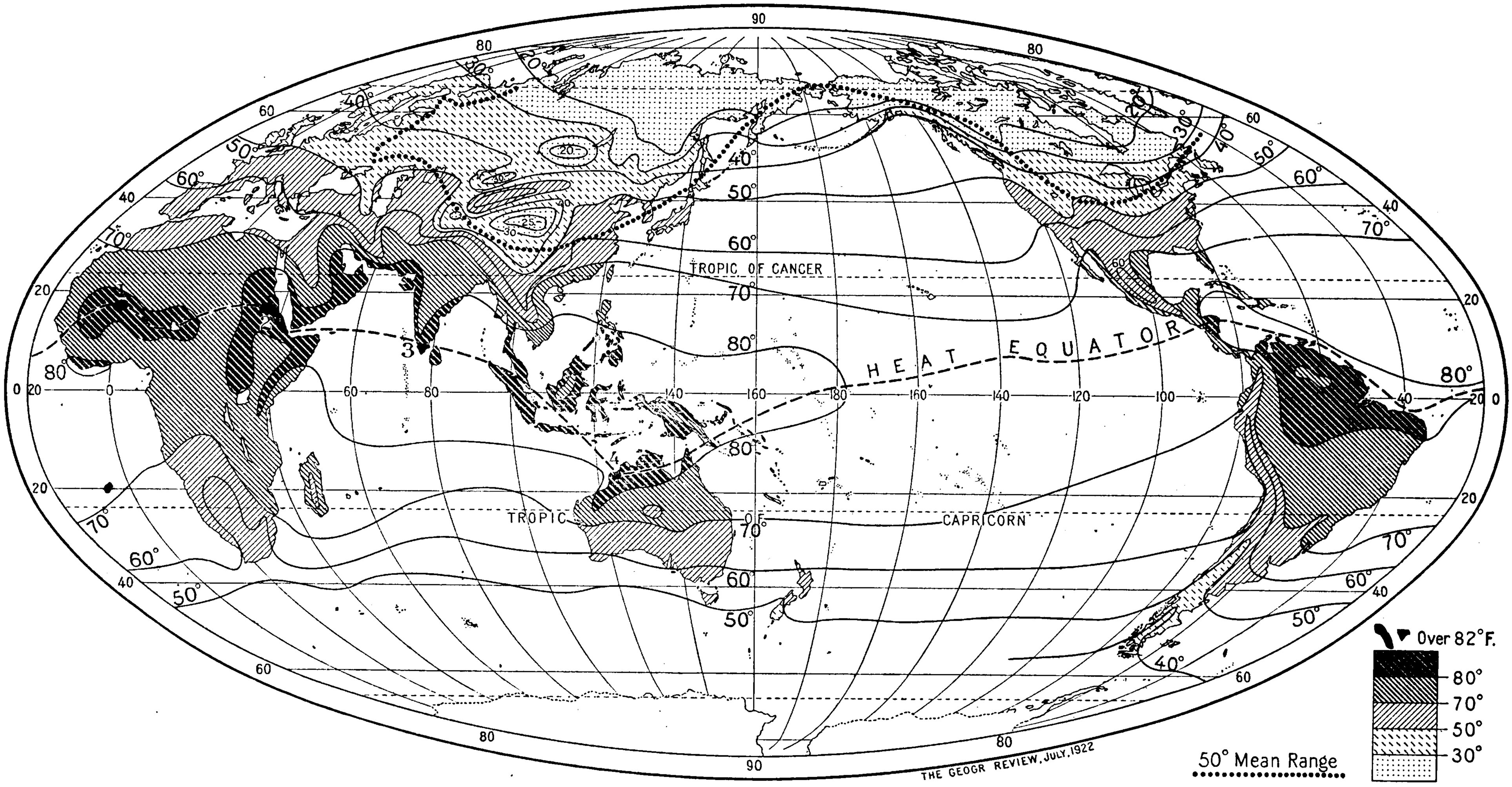


FIG. 2—Actual average annual temperature (i.e. not reduced to sea level). The region of great annual range of temperature (over 50° ) is enclosed within the dotted line. The heavy broken line shows the heat equator passing through the four hottest regions of the world: 1, Timbuktu; 2, Massowah; 3, Tinnevelli; 4, Wyndham.

cially in the Rhodesian region, where a cool loop runs north nearly to the equator. The same feature is shown in the west of South America. An interesting feature is the course of the thermal equator. It runs far south in West Australia, through Wyndham (15° 30′ S.), one of the four hottest regions in the world and far hotter than anything to the north or south of it.

In Table I the areas in the various continents experiencing specified temperatures are given.

TABLE I—APPROXIMATE LAND AREAS WITHIN GIVEN TEMPERATURE BELTS

(*Unit, 1,000 square miles*)

| VALUES | VIII | VI | IV | II | I | III | V | VII | Total |
|---|---|---|---|---|---|---|---|---|---|
| Temperature in degrees F. | Under 20 | 20–30 | 30–40 | 40–50 | 50–60 | 60–70 | 70–80 | 80+ | |
| Europe | 0 | 160 | 800 | 1,790 | 760 | 320 | — | — | 3,830 |
| Percentage | — | 4.0 | 21 | 47 | 20 | 8 | — | — | |
| Asia | 2,500 | 2,180 | 2,780 | 1,840 | 2,440 | 2,020 | 2,160 | 1,820 | 17,740 |
| Percentage | 14 | 12.2 | 15.6 | 10.4 | 13.8 | 11.5 | 12 | 10 | |
| Africa | — | — | — | — | 830 | 1,460 | 6,880 | 1,910 | 11,080 |
| Percentage | | | | | 7.5 | 13 | 62 | 17 | |
| N. and Central America | 2,400 | 1,360 | 1,200 | 1,360 | 1,140 | 1,500 | 320 | 70 | 9,350 |
| Percentage | 25.1 | 14.6 | 13.4 | 14.6 | 12.2 | 16 | 3.4 | 1 | |
| S. America | — | — | 170 | 340 | 470 | 1,460 | 3,300 | 1,420 | 7,160 |
| Percentage | | | 2.4 | 4.8 | 6.6 | 20 | 46 | 20 | |
| Australia | — | — | — | 40 | 240 | 1,180 | 1,140 | 360 | 2,960 |
| Percentage | | | | 1 | 8 | 40 | 39 | 12 | |
| Greenland | 510 | | | | | | | | 510 |
| Antarctica | 3,670 | | | | | | | | 3,670 |
| Total | 9,080 | 3,700 | 4,950 | 5,370 | 5,880 | 7,940 | 13,800 | 5,580 | 56,300 |
| Percentage | 16 | 6.6 | 8.8 | 9.5 | 10.4 | 14.1 | 24.5 | 9.9 | |

The total areas by continents in the two most favorable temperature belts (40°–60°) are as follows:

1. Asia . . . . . 4,280,000 square miles
2. Europe . . . . . 2,550,000 " "
3. North America . . . . . 2,500,000 " "
4. Africa . . . . . 830,000 " "
5. South America . . . . . 810,000 " "
6. Australia . . . . . 280,000 " "
7. Antarctica . . . . . nil

The dominant position taken by Asia is to some extent paralleled in Huntington's world map of "The Distribution of Human Energy on the Basis of Climate."[7] But however energetic a race may be it has not much chance in the struggle for existence if natural resources are wanting. When agricultural and mineral resources are also considered, it is seen (Fig. 8) that the greater part of Asia has a poor future.

We may now estimate the influence of this distribution of temperature belts on the density of white settlement. This can only be obtained empiri-

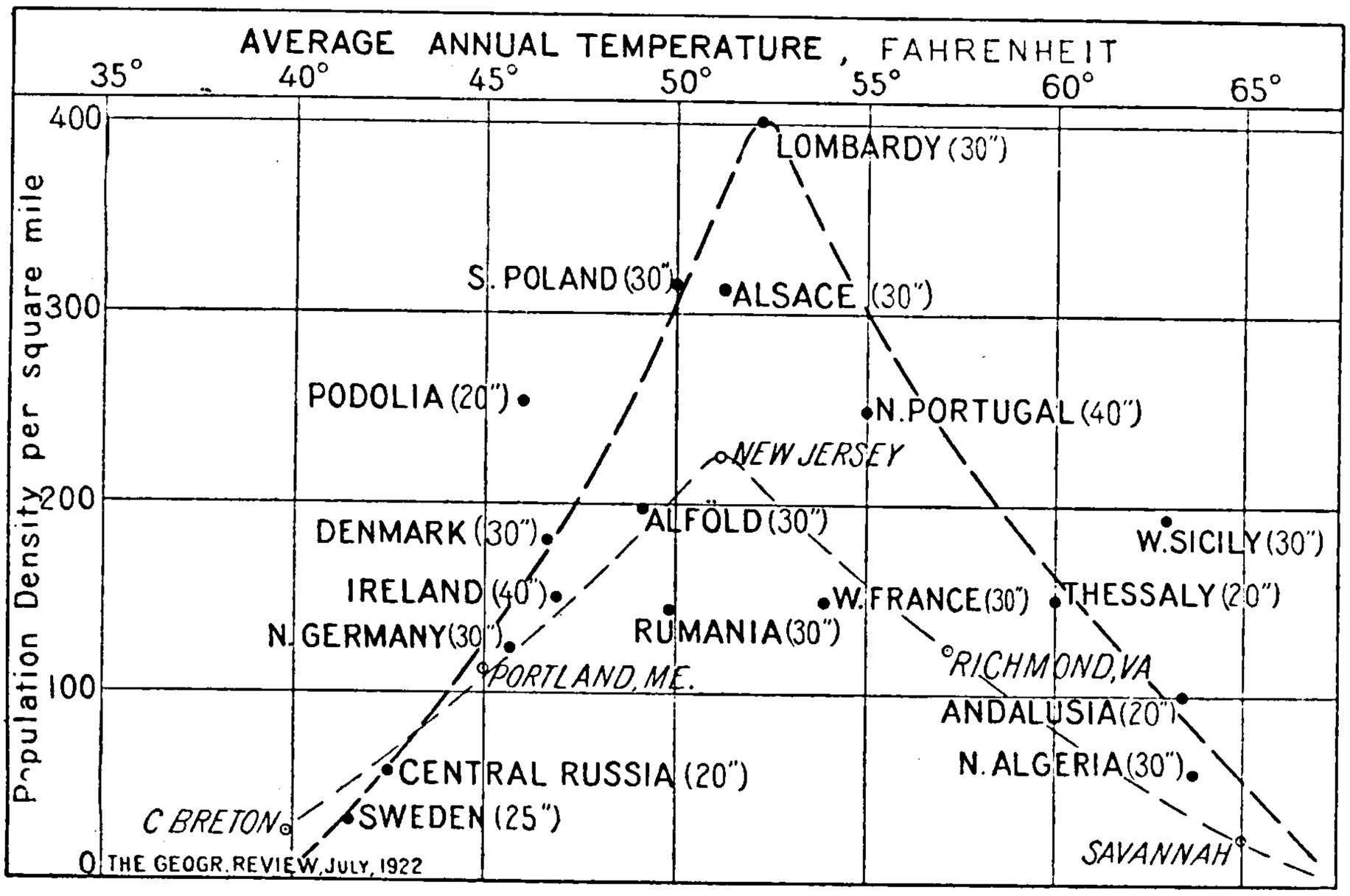


FIG. 3—Graph showing the relation between temperature and density of white population. The heavier line shows values for the European plains, coal-producing regions being omitted: the lighter line for the eastern coast of North America.

cally from data relating to the sole region where European settlement is fairly dense, that is in Europe itself.

The densest populations in Europe are distributed along the coal belt from southern Wales to Silesia. Here temperature is obviously not the main factor. Another obvious control—in this instance tending against settlement—is elevation, though here temperature is concerned as well as absence of good soils and difficulty of communications. With these two controls eliminated we find the temperature effect least complicated by other factors, that is in the *lowland regions where no coal is present.*

In Figure 3 I have charted the temperatures and population densities of almost all the plains in Europe, from the south of Sweden and central Russia with an average temperature of 42° F. to Andalusia and Algeria (which is settled by Aryan peoples) with a temperature of 63° F. These seventeen regions with one notable exception, Western France, lie fairly closely to a cuspate curve. It is to be noted that the rainfall is much the same in all these localities, from 20 to 30 inches, except in Ireland and Portugal.

[7] Huntington, *op. cit.*, p. 142.

There are, of course, considerable differences in some of the minor controls, for instance the facilities for communication and the scale of living. But, all things considered, I believe a large enough number of examples has been investigated to establish the general truth of the conclusion that a mean annual temperature of 53° F. is near the optimum for close European settlement.

On the eastern coast of North America a similar optimum occurs, though here the density of population is naturally inferior. A graph for this region is also shown in Figure 3, and it will be seen that it has much the same limits and optimum. Here the rainfall factor is nearly constant from north to south.

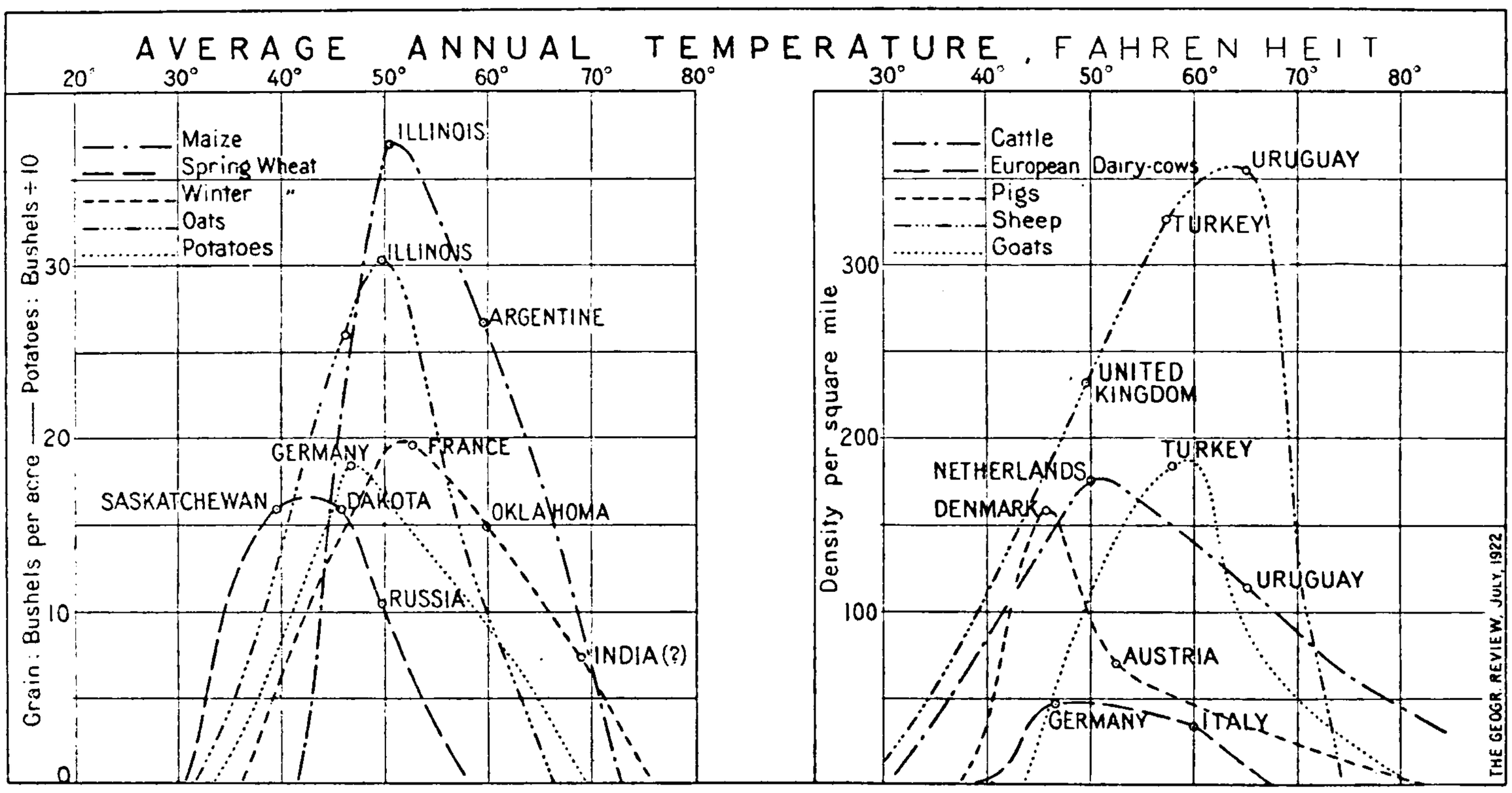


FIG. 4—Graphs showing the temperature control of production of various food crops and of stock raising. (Production data and densities from Finch and Baker.)

The temperature factor is of course variable in itself, notably as regards the annual range. While the average annual temperature is a fair criterion in general, exception must be made in the case of northern and central Asia and northern North America. Here the mean annual range exceeds 50° F. (Fig. 2), and the summer growing season is much more favorable than the annual average temperature would indicate. The summer is equal to that of many countries with an annual temperature 5° higher. I have therefore taken this into consideration, as is noted later.

Other direct controls of settlement—depending on pastoral and agricultural pursuits—may also be graphed in terms of temperature. I have found that data given in Finch and Baker's "Geography of the World's Agriculture" of great assistance in drawing up the graphs given in Figures 4–6.

The temperature controls for the main European and United States food crops of Europe and Canada and the United States are somewhat as follows. Parley grows in regions with an average annual temperature as low as

30° F. Oats, wheat (in Canada), and potatoes are also possible in such countries if the summer is relatively hot, i.e. the climate continental. The optima for barley and Canadian wheat are near 40°; for oats and potatoes near 45°; for maize in the United States near 49°; and for European wheat 51° (Fig. 4). These crops have little relative importance in regions above 60°, except the Indian wheats. It is worth noting that central Queensland, eastern Brazil, Yucatan, and Rhodesia are all regions where the climate would seem to be suitable for this winter wheat crop.

It is obvious that the temperature belt from 35° to 60° is that most favorable to grain crops (Fig. 6). However, the closest white agricultural

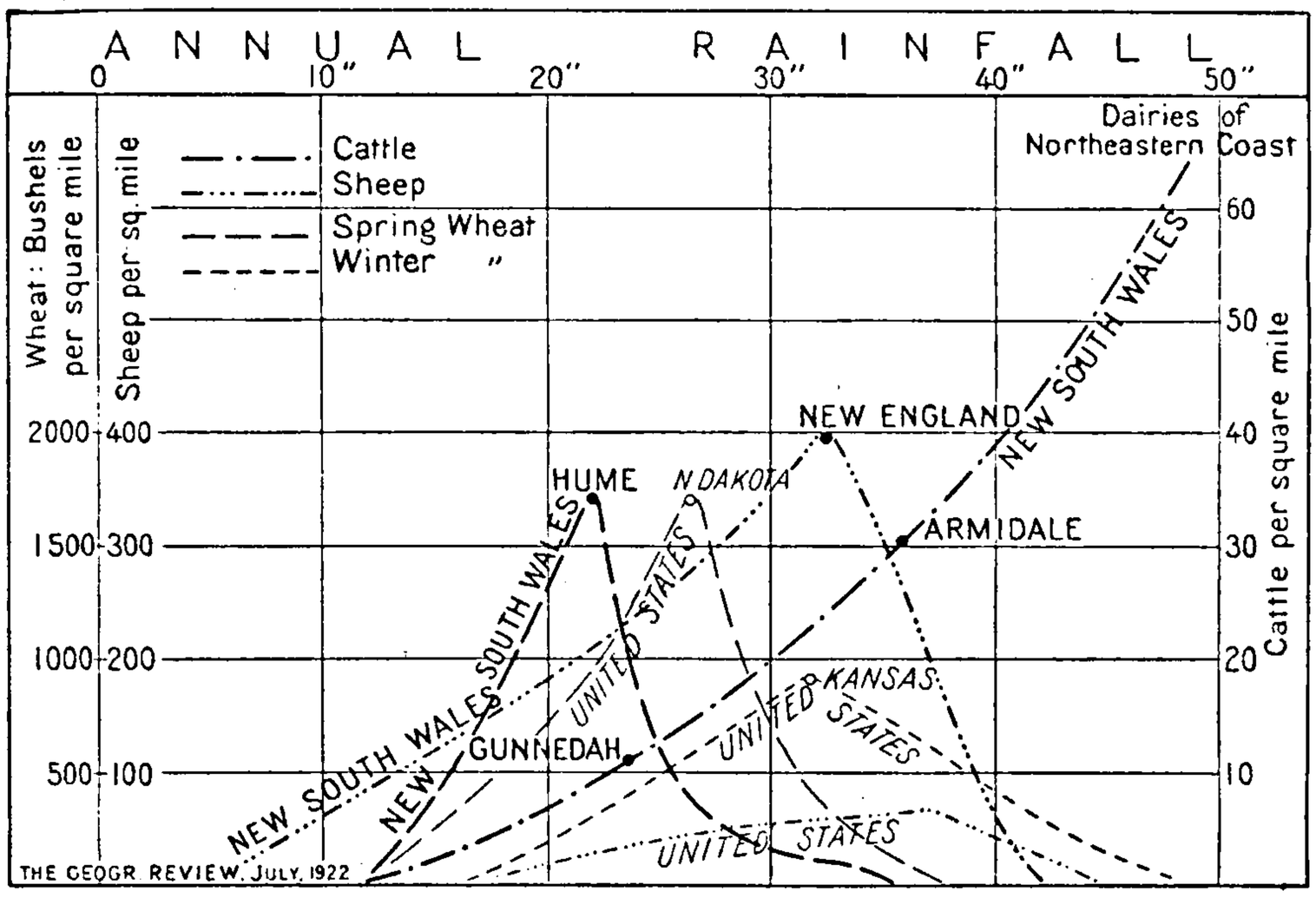


FIG. 5—Graph showing rainfall control of crop production and stock raising in New South Wales (heavier lines) and the United States (lighter lines). The curves are somewhat generalized, and it should be noted that the wheat maximum for the United States is for a whole state (Kansas), but in New South Wales for one county only.

settlement does not occur in the open prairie lands but in the mixed farming country, where the optimum temperature is distinctly higher.

The lower limit for stock is also about 30° F., sheep raising being carried on in regions with this temperature. Cattle are not much in evidence in regions below 35°, and pigs and goats about 40° (Fig. 4). According to the data in Finch and Baker's charts, the optima are somewhat as follows: pigs at 45°, cattle at about 50°, goats at 56°, and sheep at 65°. Cattle, excluding dairy cattle, range importantly through the tropics, but the other stock are not of much importance above 70° F.

## RAINFALL CONTROL

If temperature is the most important control, rainfall is easily the next most important; and, if one were ignoring the race aspect, it would rise to the chief place among the physical controls of settlement.

The lower limit of important settlement can be placed at about 15 or 20 inches of rainfall per annum. In certain favored regions, where the rainy

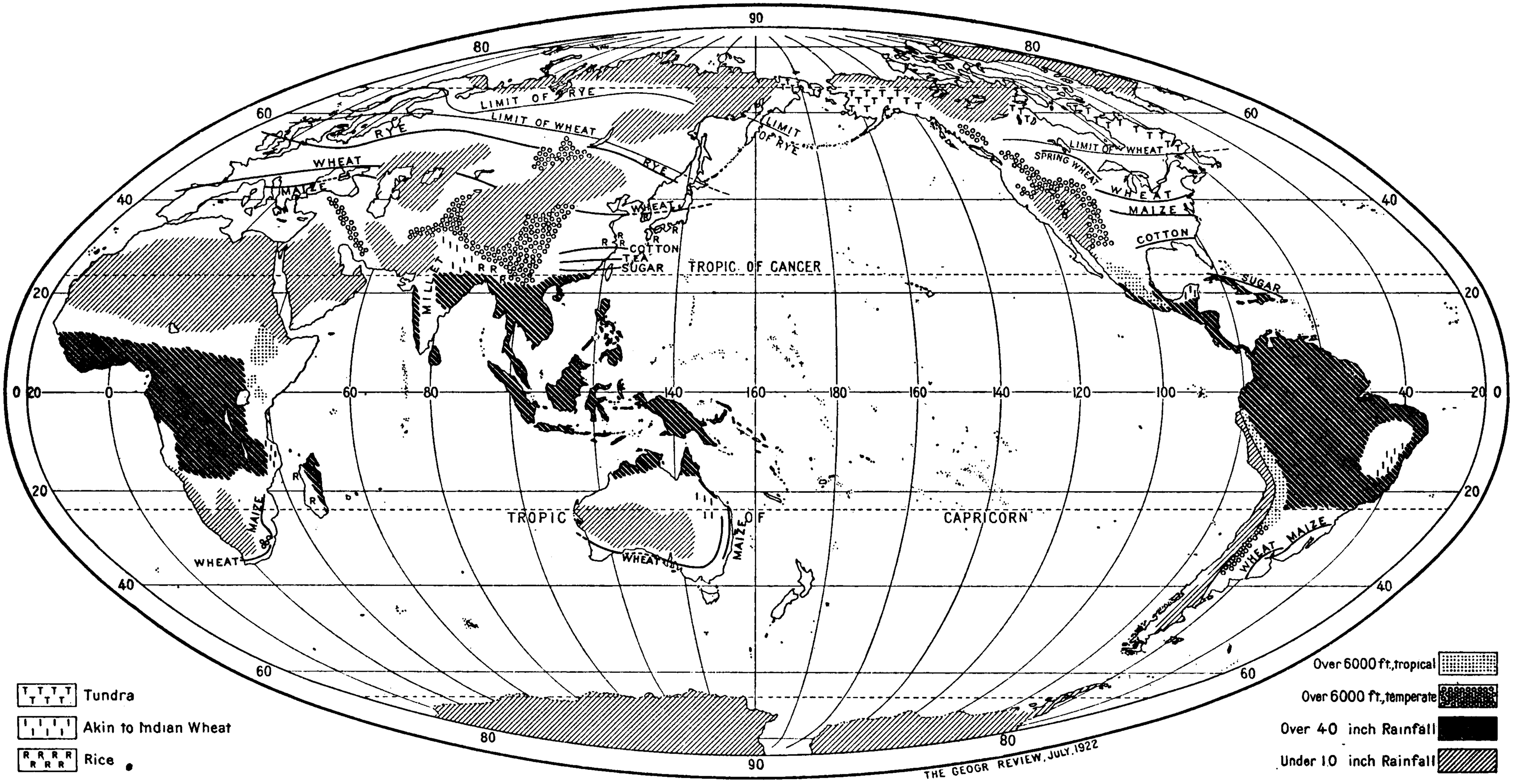


FIG. 6—Map showing in generalized form regions suitable for white settlement and crop zones of the temperate lands. Shaded areas (ruled or dotted) are largely unsuitable for white settlement.

season is very reliable and where the rain falls just at the right time, it is possible to grow wheat successfully with a rainfall as low as 10 or 12 inches. This is the case, for example, in a narrow strip of country in Western Australia, South Australia, the Mallee of Victoria, and also in parts of Oregon and the High Plains of Texas. The optimum rainfall for European settlement appears to be anywhere from 40 to 50 inches. The lower rainfall is adequate in cooler regions; the higher is not too much in regions where the evaporation is very rapid, unless it is somewhat concentrated in the summer months when the wet bulb readings are too high for comfort, as is the case for instance in Brisbane. A rainfall of over 60 inches is generally a disadvantage, though we may note such exceptions as the heavy seasonal rainfall of certain tropical regions—portions of India and Mexico, for instance—where water is stored for use in a long dry season.

In Figure 6 I have plotted the rainfall control as it affects settlement in southeastern Australia about latitude 34° S. Here there is a very uniform decrease in rainfall from 50 inches at the coast to 8 inches near Broken Hill. Dairy cattle are densest on the coast with the maximum rainfall, while cattle are unimportant in the region below 12 inches. Sheep reach a maximum density at about 32 inches, but range from 42 inches downwards. Wheat is grown between 12 and 28 inches, with a maximum at 22 inches.

It is important to note that the great cattle and sheep regions are not those semi-arid districts usually so designated in Australia, but that by far the greater number are reared in the wetter regions, where their importance is apt to be lost sight of among the many other occupations of the settlers. As regards the vast arid expanses of Australia with a rainfall below 10 inches, only a very small percentage (i.e. about two or three per cent) is grazed there, and it will never bulk importantly among the pastoral regions of the world. Similar conditions obtain in the other arid regions.

## World Agriculture

From the point of view of white settlement there are four types of land surface which are unsuitable. These are the tundras of the polar regions, which are too cold for our ordinary domestic animals and also usually too dry (development of a large-scale reindeer industry remains to be seen). Secondly, and most important, the desert regions of the world, which are too dry for agriculture though a certain amount of stock can live therein. Thirdly, the rugged mountainous regions and the high plateaus of the colder belts. In tropical regions, of course, the plateaus are much more favorable for settlement, but unfortunately they are not very extensive. Huntington, however, believes that most tropical plateaus suffer from the excessive monotony of their climate.[8] The healthy *variety* of temperate regions is absent. On the other hand, Dr. Bowman writes concerning the tropical

[8] See, for instance, his article, "The Relation of Health to Racial Capacity: The Example of Mexico," *Geogr. Rev.*, Vol. 11, 1921, pp. 243–264.

plateaus:[9] "I was very much surprised to find that there are two distinct seasonal climaxes, one at the height of summer and one at the height of winter; and for the plateaus of Peru and Bolivia these climaxes endure for a period of about six weeks, with very important effects upon the life of the region." Fourthly, there are the hot wet regions of the tropics, whose natural resources are abundant but whose climate is quite unsuited for close white settlement or indeed for any white settlement requiring constant manual labor.

In Figure 6 these four types are given in a generalized form. Here the regions left blank are those suited for European settlement of some sort. Almost the whole of Europe and North America is available, about half of Asia and Australia, and relatively small proportions of Africa and South America.

In the moderately watered tropical regions a considerable population of *pastoral* whites will probably develop. In my opinion there is no prospect of a large agricultural settlement there. In temperate regions I have inserted the zones where the most important crops thrive.

In the northern hemisphere the zones, like the chief mountain ranges, run for the most part from east to west. These zones are broken by the arid and mountainous regions. In the southern hemisphere the trend lines of the continents run north and south. The crop belts more or less agree with this direction. In no case does the crop region extend to the desert areas, but a belt of stock country always occupies the margins of the desert.

The optimum of the wheat crop is near the optimum of white settlement in northern lands. In southern lands the present wheat optimum—in easily tilled prairies—is on the arid side of the optimum of white settlement.

## Coal Control

Coal has been described as the "mother of industry." There is no doubt that the great industrial settlements will remain for many generations where power is cheap. The mobile hydro-electric power is not likely to be a serious rival of coal, except for certain specialized industries, for very many years.

The most striking feature of the world distribution of coal is the way in which all the major reserves are clustered along or near the 50° isotherm.[10] This coincidence may indicate that the climates of past ages have on the whole not varied very largely, and that the coal-forming vegetations grew under warm temperate conditions. Probably our present world temperatures are rather lower than usual—for we are living in the later stages of the Pleistocene Ice Age.

The total coal reserve—so far as is known at present—is approximately $7{,}937 \times 10^9$ tons.

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[9] Letter to the author.

[10] In 1913 the Geological Congress at Toronto arranged for a survey of the world's reserves of coal. I have used the ensuing volumes very freely in this section of the paper.

Of this colossal amount almost 90 per cent occurs in the seven countries given below:

| | |
|---|---|
| United States | 3,838 x $10^9$ tons |
| Canada | 1,234 x $10^9$ tons |
| China | 995 x $10^9$ tons |
| Germany | 423 x $10^9$ tons |
| United Kingdom | 189 x $10^9$ tons |
| Siberia | 173 x $10^9$ tons |
| Australia | 165 x $10^9$ tons |
| Total | 7,017 x $10^9$ tons |

The more one studies the resources of the world the more astounding is the position of the United States. That country is most highly favored in respect of temperature, rainfall, coal—so that the center of the world's industry and of the white population will inevitably move across the Atlantic from Europe to North America.

In the *Fortnightly Review* of February, 1918, "Politicus" discusses the effect of the coal factor somewhat as follows:

> Coal production and the birth rate are closely related; for only where there is cheap power can the densest civilized populations obtain remunerative wages in the many factories dependent on the coal. Hence the so-called "decay of the French nation" is almost entirely due to her poverty in coal and iron, which largely depended on German aggression in 1871. Almost all the growth of German population has occurred in the coal and iron towns, whose expansion has only been exceeded by the western towns of the United States. On the other hand, the German rural population was less in 1910 than in 1871. . . .

Similar results are to be expected in the other coal regions of the world, which makes Table II of vital interest in the question under discussion. In this table I have discussed separately the several well-defined coal fields which occur in some of the countries (e.g. Germany) listed.

It may be objected that we have no accurate knowledge of the geological formations through large areas of the world. This is no doubt true of much of the tropical forest country in Brazil and Africa; but here, as we have seen, close white settlement is not likely to take place owing to climatic disabilities. Much of the tropical deserts and grasslands has been prospected, at any rate to such an extent that the chances of finding a coal field rivaling those of the seven important regions is not probable. For instance, in the great area of arid Australia with hardly an inhabitant, it is safe to say that there is no likelihood of a large coal field anywhere—though some seams may be found in the northwest. When one thinks of the ubiquitous prospector for precious minerals—and of late for oil—it seems improbable that Table II will be materially altered.

I have not thought it necessary to consider other mineral deposits in this world-wide survey. Petroleum is a vital factor in our present day civilization. Distribution of its production must change within a short space of

time,[11] but no great change in settlement is likely to be effected thereby, for oil is a peculiarly transportable product. Iron ore is generally carried to the coal fields. Gold and other deposits do not lead to settlement to the

TABLE II—CHIEF COAL RESERVES OF THE WORLD

*(Based on the Reports of the Geological Congress of 1913)*

| No. | Locality | Tons Estimated x $10^6$ | Kind of Coal | Remarks |
|---|---|---|---|---|
| 1 | United States Northern Plains | 1,175,000 | Largely lignite | Black Hills and Colorado are bituminous |
| 2 | Canada, Alberta | 1,000,000 | Lignite or soft coal | Bituminous in center; anthracite along west |
| 3 | United States, Rockies | 1,000,000 | Bituminous<br>Anthracite | In Montana<br>In Utah, etc. |
| 4 | China, Shansi | 714,340 | Anthracite | Possibly best field in the world |
| 5 | United States, Eastern | 500,000 | Anthracite | Chiefly Pennsylvania, Ohio, and W. Virginia |
| 6 | United States, Central | 500,000 | Anthracite | Chiefly Illinois and Missouri |
| 7 | Germany, Westphalia | 212,000 | Bituminous | |
| 8 | Germany, Silesia | 166,000 | Bituminous | |
| 9 | China, Yunnan, etc. | 140,000 | Anthracite and bituminous | Also Hunan and Szechwan |
| 10 | England (total) | 125,000 | Bituminous | Carboniferous |
| 11 | New South Wales | 115,000 | Bituminous | Permo-Carboniferous |
| 12 | Canada, British Columbia | 70,000 | Chiefly bituminous | Crow's Nest |
| 13 | Canada, Saskatchewan | 57,400 | Lignite largely | Cretaceous, etc. |
| 14 | Transvaal | 56,200 | Chiefly bituminous | |
| 15 | Russia, Donetz | 55,000 | Chiefly anthracite | |
| 16 | India, Raniganj | 53,000 | Bituminous | |
| 17 | Wales | 40,000 | Bituminous-anthracite | |
| 18 | Bohemia | 40,000 | Bituminous-anthracite | Pilsen and Prague |
| 19 | Victoria, Morwell | 30,000 | Brown coal | Tertiary |
| 20 | Colombia | 27,000 | Bituminous | |
| 21 | India, Hyderabad | 23,000 | Bituminous | |
| 22 | Scotland | 22,000 | Bituminous | |
| 23 | United States, Texas | 21,000 | Lignite | |
| 24 | Indo-China | 20,000 | | |
| 25 | Germany, Saar | 16,000 | | |
| 26 | Siberia, Irkutsk | 15,000? | | Total reserves in Siberia said to be 173 x $10^9$ |
| 27 | Siberia, Kuznetz | 12,500 | Chiefly brown coal | |
| 28 | Belgium | 11,000 | Bituminous | |
| 29 | France | 11,000 | Chiefly bituminous | |
| 30 | Spitsbergen | 8,750 | Bituminous | |
| 31 | Spain | 8,750 | | |

[11] David White: The Petroleum Resources of the World, *Annals Amer. Acad. of Polit. and Soc. Sci.*, Philadelphia, Vol. 89, 1920, pp. 111–134.

same extent that coal does. While the gold discoveries of 1851 accelerated the settlement of Australia, few of the large number of immigrants ultimately engaged in gold mining—they turned to farming, etc. In Australia today it has been estimated that only about 120,000 people dwell in gold fields which are remote from agricultural districts.

## Location Factor

We have considered the three major factors determining close European settlement. Of those remaining, soil and communications are perhaps the chief. Both of these depend largely on elevation: almost all the largest areas of good soil and of easy communication are plains below 2,000 feet elevation. Speaking generally, elevation is a disadvantage, for it always implies heavy transport difficulties. Tropical plateaus are an improvement on tropical lowlands for white settlers inasmuch as they come nearer to the optimum temperature; but this is expressed by the temperature scale in our estimate of the value of the region under consideration. We can therefore use a *location scale* ranging upwards from an optimum at sea level and trust to the temperature control to express the healthier conditions of tropical plateaus.

## Other Factors

It will be found that almost all the factors influencing human settlement are based on the four considered above. Health is controlled primarily by temperature and humidity—of which the latter is closely related to rainfall. Agriculture is concerned with rainfall and temperature. A rich soil is not vital in these days of fertilizers. Thus in the Australian Mallee and other regions of an extremely sandy nature an addition of superphosphate gives a payable wheat yield. In the future, artificial manures will be of increasing importance; but the natural controls of temperature and rainfall can never be altered.

Irrigated regions are perforce not properly represented in this scheme. Except in Egypt and Mesopotamia they are not likely to build up vast populations in desert countries. In Australia, for instance, the irrigated lands form only one part in ten thousand of those which require more rainfall, and this small proportion will never be sufficiently increased to be of much importance.

Pastoral industries are determined almost wholly by rainfall and not by temperature; for some varieties or other of cattle, sheep, or allied animals range throughout the continents, excluding only the permanent ice caps and the dense tropical forests. Industrial settlement, the great feature of modern life, is dependent essentially on temperature and coal. We have noted that there are practically no coal fields in arid regions.

It is impossible to discuss every factor. Fisheries, which from the most ancient times have been a factor of local importance, are ignored, and they lead to some fairly important populations today.

The psychical factor, for instance the influence of religion and of genius, in determining man's environment is an aspect which does not lend itself to quantitative representation.

## The Econograph

The most difficult feature in this research was to compare the values of the four major controls of white settlement. I was only able to arrive at what seems a fairly satisfactory conclusion in regard to the order of importance of the factors of temperature, rainfall, coal, and location by a method of trial and error. The problem may be simplified by considering the effect of location and coal supply first.

The location factor is of much less importance than the other three. As long as the regions are on the average below 1,500 feet or so this factor is not vital as regards communications, etc. Above 1,500 feet a handicap is introduced; but only in a few cases does this factor exert paramount influence over regions, though admittedly it determines certain important ports and junction towns. We may, therefore, for a time ignore the location factor.

With regard to coal it is only possible to see how this factor influences the population of a country by comparing it with an adjoining country not blessed with this asset.

Table III—Influence of Coal on Density of Population

| Country Rich in Coal | | Small or No Coal Supply | | Ratio |
|---|---|---|---|---|
| Bohemia | 315 | Hungary | 160 | 1.9 |
| Germany | 324 | France | 191 | 1.7 |
| Poland | 193 | Western Russia* | 94 | 2.0 |
| Britain | 460 | Ireland | 140 | 3.2 |

* Four adjacent proVinces equal in area to Poland.

The above comparisons are by no means exhaustive, and some striking exceptions, such as Italy, can be found; but they serve to show that, under present conditions in Europe, the presence of abundant coal and the resulting industries have about doubled the population in the countries so favored.

We are now faced with the following problem. We have three paramount factors, temperature, rainfall, and coal, which practically control the white settlement of today with the exception of a few mining districts. We have a continent, Europe, where these factors have operated for so long a period that it may be assumed that under present economic conditions the population is distributed largely in direct response to these factors.

I have divided Europe into eight natural regions whose population density varies greatly, from that of the British Isles to that of the Tundra. Assuming that one knew the exact relative values of the factors temperature and

rainfall one could express this as an area (i.e. temperature x rainfall) which could be equated with the population resulting therefrom.

Since the density of population depends directly on the variables temperature and rainfall, the theory of variation tells us that we may use the product, temperature factor x rainfall factor, to represent the density. This can be expressed as an area; and this area (triangle *A B O* in Fig. 7) forms the basis of the empirical graph which I use to compare the seventy-four regions of the world.

My method has been to arrive at the relation of the temperature factor to the rainfall factor by assuming various values and testing them against the actual population map of Europe.

It was logical to start off by giving the optimum temperature and optimum rainfall equal values. Hence a country with an average temperature of 55° F. and an average rainfall of about 50 inches would be represented by a right angled triangle with two sides of equal length. If in addition it had the optimum amount of coal of some 200 x $10^4$ tons per square mile, then this triangle would be doubled in area by adding another axis to the right of equal value to the other two.

We may then draw corresponding triangles or quadrilaterals for the eight regions of Europe (using the above dimensions for the optimum values). The areas of the eight figures will stand in a certain relation to each other. If our premises are correct, these areas will be proportional to the actual populations of the regions concerned. If our factors are wrongly related, then the population densities (or isopleths expressing the populations) will not at all agree with the areas of our figures.

This is the method of trial and error which I have used. The "test" areas using equal lengths for the temperature, rain, and coal axes did not give isopleths corresponding to the actual population lines, which should result from the plotting of such axes in the manner described. If, however, the relation shown in Figure 7 be made use of, where the temperature control is given double the weight of the rainfall, while the coal factor, if extremely large, may double the area, then the resultant economic graphs for certain fully developed regions agree fairly with their respective populations.

The writer is prepared for some adverse criticism of this method, but he feels that there is much to be gained by the use of these comparative graphs. He would remind readers that the introduction of a similar method of comparing climates by the climograph[12] has led to a number of interesting papers on comparative climatology, in which moreover useful suggestions for improving this graphic method have been made. The writer hopes for the same happy result from the present paper.

The "econograph" is a rectangular figure formed on four axes which represent, respectively, the average annual temperature, the average annual rainfall, the average elevation, and the (estimated) total coal reserve of the region.

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[12] *Geogr. Rev.*, Vol. 4, 1917, pp. 401–403.

The ideal region would have an econograph like that shown in Figure 7. The temperature would be 55° F.; the rainfall 50 inches; the region would be at sea level; and the coal supply 200 x $10^4$ tons per square mile. It will be seen that the temperature and rainfall give the triangle *A B O*, while the presence of a large coal supply doubles this by adding the triangle *A O D*. The location effect is shown by the small area below the line *B D;* it is not of much importance save that if a region be mountainous, this area almost disappears.

In the scale used the area of the ideal econograph occupied 1,000 units. All the seventy-four regions were below this ideal, though Britain and North China each totaled 770 units. It is my purpose to show that the area of the econograph represents the habitability of the region as closely as one can expect to assess it in the present state of our knowledge.

In Table IV I have recorded the economic factors. The first column gives the area of the region. The next four columns can be used to plot the econographs according to the scales on the ideal graph.

Variation of the shape of the econograph may be studied with profit. A symmetrical graph, like that of Britain, indicates that a region is well equipped for agricultural or industrial occupations. If only the left side is present, it is chiefly an agricultural or pastoral region, e.g. Central Russia. In a few cases the right side predominates, as in the Utah region, which means that the coal reserves are likely to be of greater value than the agricultural resources. Where the lower triangle (below the horizontal axis) is large the region possesses extensive lowlands and is likely to have large areas suited for intense cultivation, e.g. Southern Russia. Where it is small the country is elevated and usually not well suited for agriculture, e.g. Norway.

Somewhat similar indications are given by the length of the diagonals (or axes). If the upper axis is long, then the region will have a comfortable climate, e.g. Britain or Southern California; and if it be short, the converse is the case, e.g. Norway or most tropical regions. A short axis to the left is unfavorable for white farming but is often suitable for a pastoral occupation. A wet mountainous region, where hydro-electric energy is usually plentiful, is shown by a short lower axis combined with a long axis to the left, e.g. Southern Chile. The desert regions have a characteristic elongated shape ranging from the moderately arid type, such as Southern California, to the almost entirely useless types of the Tundra or the Thar.

## World Isoiketes

If now the numbers representing the areas of the regional econographs, and thus the habitability of the regions, be plotted on a map of the world (as in Fig. 8), we can draw lines through the numbers and form a sort of contour map. To such a line I gave the name "isoikete" (from *οἰκητός*, habitable).[13]

[13] *Geogr. Rev.*, Vol. 8, 1919, p. 112.

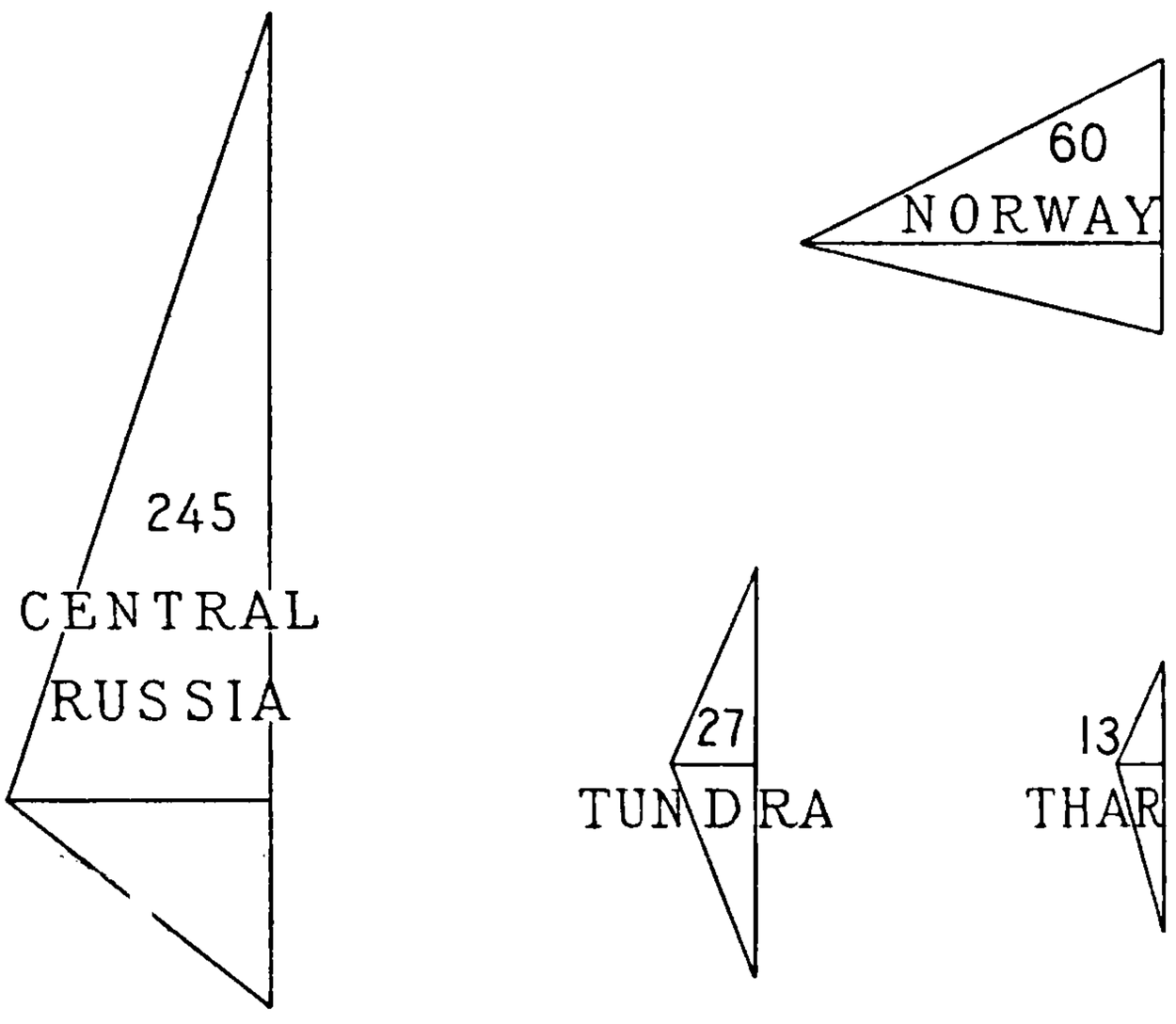
(FAHR

COAL

10,000 TONS PER SQ MILE)

50 100 0

D

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econograph and examples of its application. The econograph is an empirical
ntrols of settlement. Its area is approximately proportional to the habitability
or the ideal region is taken as 1000 units. The standard graph is repre-

TABLE IV—ECONOMIC FACTORS OF THE REGIONS

| REGION | AREA (square miles x $10^3$) | AVERAGE ANNUAL TEMP. (degrees F.) | ANNUAL RAIN-FALL (inches) | AVERAGE ELEVA-TION (feet) | TOTAL COAL RESERVE (tons x $10^4$) | COAL PER SQ. MILE (tons x $10^4$) | AREA OF ECONO-GRAPH (1,000 units = max.) |
|---|---|---|---|---|---|---|---|
| *Europe* | | | | | | | |
| British Isles | 120 | 50 | 40 | 600 | 190 | 160 | 770 |
| Franco-Prussia | 422 | 50 | 30 | 600 | 250 | 60 | 620 |
| Poland (with S. W. Russia, etc.) | 400 | 50 | 28 | 600 | 200 | 50 | 565 |
| Central Russia | 1,200 | 45* | 20 | 600 | 55 | 4 | 245 |
| Mediterranean | 545 | 60 | 20 | 1,500 | — | — | 210 |
| Northern Russia | 461 | 38 | 15 | 600 | — | — | 65 |
| Norway | 125 | 28 | 38 | 3,000 | — | — | 60 |
| Tundra | 600 | 29* | 9 | 600 | — | — | 12 |
| *Asia* | | | | | | | |
| Northern China | 360 | 55* | 30 | 1,500 | 714 | 200 | 770 |
| Japan | 300 | 55 | 40 | 2,000 | — | — | 484 |
| Southern China | 588 | 68 | 65 | 2,000 | 140 | 24 | 288 |
| Mediterranean | 158 | 60 | 18 | 3,000 | — | — | 180 |
| Siam | 750 | 75 | 60 | 1,000 | 20 | 3 | 136 |
| Manchuria | 940 | 30* | 20 | 1,500 | — | — | 120 |
| Western Siberia | 768 | 35* | 15 | 600 | 13 | 2 | 120 |
| Ceylon | 25 | 80 | 30 | 1,500 | — | — | 78 |
| Deccan | 588 | 75 | 20 | 1,200 | — | — | 72 |
| Persia | 1,000 | 55 | 10 | 3,000 | | | 66 |
| Eastern Siberia | 740 | 30* | 12 | 2,000 | 15 | 2 | 45 |
| East Indies | 800 | 80 | 80 | 2,000 | — | — | 43 |
| Aral | 1,100 | 50* | 6 | 600 | | | 40 |
| Altai | 820 | 30* | 15 | 4,500 | | | 35 |
| Tibet | 2,100 | 30* | 12 | 12,000 | — | — | 30 |
| Tundra | 3,220 | 20* | 10 | 600 | — | — | 27 |
| Arabia | 1,372 | 75 | 10 | 1,500 | | | 20 |
| Tarim | 750 | 55* | 6 | 3,000 | | | 20 |
| Thar | 263 | 80 | 5 | 600 | | | 13 |
| Northern India | 870 | 75 | 40 | 1,000 | 76 | 9 | 140 |
| *Australia* | | | | | | | |
| Victoria | 172 | 55 | 30 | 1,000 | 30 | 18 | 575 |
| Eastern Coast | 98 | 65 | 40 | 2,000 | 115 | 110 | 574 |
| New Zealand | 104 | 50 | 50 | 2,000 | | | 430 |
| Tasmania | 26 | 50 | 40 | 1,200 | | | 400 |
| Swanland | 172 | 60 | 20 | 1,000 | | | 225 |
| Queensland | 282 | 73 | 25 | 1,000 | | | 143 |
| Lachlan | 245 | 65 | 15 | 500 | | | 119 |
| Northern Coast | 578 | 80 | 25 | 800 | | | 70 |
| Southern arid | 835 | 65 | 7 | 1,200 | | | 40 |
| New Guinea | 343 | 77 | 100 | 2,000 | | | 21 |
| Northern arid | 565 | 75 | 9 | 1,000 | | | 16 |

* Temperate region with hot (continental) summer; 5° F. added on econograph axis.

TABLE IV—ECONOMIC FACTORS OF THE REGIONS (*continued*)

| REGION | AREA (square miles x $10^3$) | AVERAGE ANNUAL TEMP. (degrees F.) | ANNUAL RAIN-FALL (inches) | AVERAGE ELEVA-TION (feet) | TOTAL COAL RESERVE (tons x $10^4$) | COAL PER SQ. MILE (tons x $10^4$) | AREA OF ECONO-GRAPH (1,000 units = max.) |
|---|---|---|---|---|---|---|---|
| *Africa* | | | | | | | |
| Natal | 140 | 60 | 30 | 3,000 | | | 300 |
| Transvaal | 264 | 62 | 20 | 3,000 | 56 | 21 | 273 |
| Cape | 128 | 59 | 20 | 1,500 | | | 225 |
| Rhodesia | 1,250 | 72 | 40 | 3,000 | | | 180 |
| Madagascar | 227 | 72 | 40 | 1,500 | | | 136 |
| Algeria | 390 | 68 | 20 | 2,000 | | | 125 |
| Congo | 1,587 | 78 | 70 | 1,000 | | | 76 |
| Uganda | 770 | 75 | 30 | 3,000 | | | 68 |
| Sudan | 2,080 | 79 | 35 | 1,500 | | | 65 |
| Kalahari | 500 | 63 | 8 | 3,000 | | | 48 |
| Northern Sahara | 2,466 | 68 | 20 | 1,000 | | | 16 |
| Southern Sahara | 1,338 | 78 | 5 | 1,000 | | | 10 |
| *North America* | | | | | | | |
| Northeastern states | 747 | 50 | 35 | 1,000 | 1,000 | 135 | 755 |
| Inland plains | 592 | 60 | 20 | 2,300 | 1,175 | 200 | 675 |
| Alberta | 630 | 40* | 15 | 2,500 | 1,000 | 170 | 420 |
| Utah | 250 | 45 | 10 | 5,000 | 500 | 200 | 345 |
| Southeastern states | 486 | 65 | 40 | 1,000 | 21 | 4 | 326 |
| Eastern Canada | 960 | 40* | 27 | 1,000 | | | 315 |
| Oregon | 246 | 55 | 25 | 3,000 | | | 315 |
| Southern Rockies | 510 | 65 | 12 | 5,000 | 500 | 100 | 300 |
| British Columbia | 345 | 38 | 40 | 2,500 | 70 | 20 | 286 |
| Central America | 592 | 70 | 60 | 3,000 | | | 165 |
| West Indies | 100 | 78 | 50 | 1,000 | | | 120 |
| Southern California | 444 | 63 | 10 | 2,000 | | | 72 |
| Tundra | 1,910 | 15* | 12 | 1,000 | | | 15 |
| *South America* | | | | | | | |
| Uruguay | 750 | 65 | 35 | 1,000 | | | 315 |
| Southern Chile | 131 | 45 | 70 | 3,000 | | | 272 |
| Western Argentine | 525 | 60 | 20 | 800 | | | 210 |
| Central Chile | 78 | 55 | 15 | 3,000 | | | 184 |
| Andean plateau | 525 | 63 | 15 | 8,000 | | | 112 |
| Colombia | 945 | 78 | 40 | 1,000 | 27 | 3 | 95 |
| Central Brazil | 1,820 | 78 | 70 | 1,000 | | | 91 |
| Eastern Brazil | 328 | 75 | 25 | 1,000 | | | 78 |
| Amazons | 1,969 | 80 | 80 | 500 | | | 65 |
| Northern Chile | 210 | 60 | 3 | 5,000 | | | 60 |
| Patagonia | 78 | 45 | 10 | 1,200 | | | 45 |

* Temperate region with hot (continental) summer, 5° F. added on econograph axis.

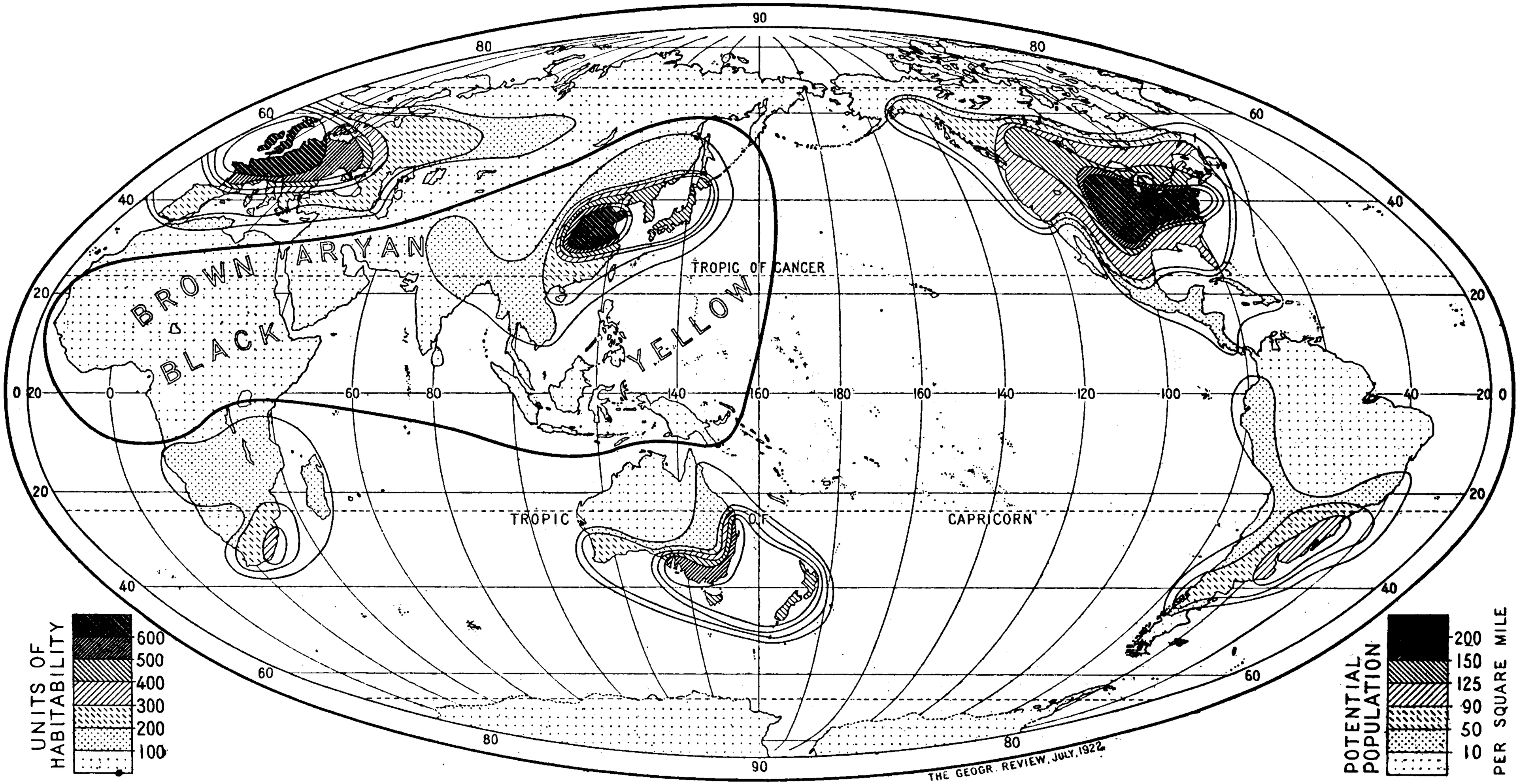


FIG. 8—The distribution of future white settlement according to the economic value of the world regions (see Fig. 1 and Table IV). The area within the heavy black line is not available for white settlement but has been treated uniformly here. The facts of the distribution shown in this figure may be expressed by degree of habitability, shown by "isoiketes" (see legend to the left) where the optimum of habitability is 1000, or by the corresponding potential population density (see legend to the right).

Figure 8, drawn in this fashion, presents many points of interest. There are three first-class centers of (white) habitability, two of the second class, besides many areas in North America around the major centers. These are shown in Table V.

TABLE V—POTENTIAL REGIONS OF CLOSE WHITE SETTLEMENT

| CLASS | UNITS OF HABITABILITY, 1000 = max. | REGION AS DEFINED IN FIGURE 1 | PRESENT SETTLEMENT |
|---|---|---|---|
| I | 770 | British Isles | Closely settled |
| | 620 | Franco-Prussia | Closely settled |
| | 770 | Northern China | Not available for whites |
| | 756 | Northeastern states of the United States | Moderately settled |
| | 675 | Inland plains of the United States | Sparsely settled |
| II | 565 | Poland, Austria, etc. | Closely settled |
| | 575 | Victoria (Australia) | Moderately settled |
| | 565 | Eastern coast of Australia | Moderately settled |
| III | 484 | Japan | Not available for whites |
| | 430 | New Zealand and Tasmania | Sparsely settled |
| | 420 | Alberta | Sparsely settled |
| IV | 315 | Uruguay | Moderate settlement |
| | 300 | Natal | Moderate settlement (not wholly available) |
| | 345 | Utah | Dry, sparsely settled |
| | 326 | Southeastern states of the United States | Moderately settled |
| | 315 | Eastern Canada | Sparsely settled |
| | 315 | Oregon | Sparsely settled |
| | 300 | Southern Rockies | Dry, sparsely settled |
| V | 286 | British Columbia | Sparsely settled |
| | 288 | Southern China | Not available for whites |
| | 250 | Southern Chile | Sparse |
| | 245 | Central Russia | Fairly close settlement |
| | 225 | Swanland | Sparsely settled |
| | 213 | Transvaal | Sparsely settled |
| | 210 | Western Argentine | Sparsely settled |
| | 210 | Mediterranean | Closely settled |

The first eight regions (Classes I and II) in Table V are all endowed with a plentiful coal supply. In the third class come two regions, Japan and New Zealand, with poor coal supplies but excellent climatic controls. The enormous coal supply of Alberta is balanced by its long winter, so that it appears rather low down amid the most attractive regions.

TABLE VI—Regions of Potential Moderate White Settlement

| Class | Units of Habitability | Region | Remarks |
|---|---|---|---|
| VI | 180 | Rhodesia | Sparsely settled |
| | 180 | Anatolia | Largely occupied |
| | 168 | Central Chile | Largely occupied |
| | 165 | Central America | Largely occupied |
| | 143 | Queensland | Sparsely settled |
| | 140 | Northern India | Not available |
| | 136 | Siam | Not available |
| | 136 | Madagascar | Not available |
| | 125 | Algeria | Largely occupied |
| | 120 | Western Siberia | Sparsely settled |
| | 120 | West Indies | Largely occupied |
| | 120 | Manchuria | Not available |
| | 119 | Lachlan | Sparsely settled |
| | 112 | Andean plateau | Largely occupied |

In this class Rhodesia, central Queensland, Western Siberia, and the Darling Basin offer large areas for settlement which may be used for ranching or, in places, for dry farming.

The remaining regions of the world comprise the tundras, deserts, and hot wet countries where even moderate white settlement is unlikely. A considerable development of the pastoral industry with sparse white settlement is of course probable in the more favorable areas.

Table VII—Approximate Density Values for Econograph Areas

| Econograph Area | Population Density per Square Mile |
|---|---|
| 600 units | 200 |
| 500 | 150 |
| 400 | 125 |
| 300 | 90 |
| 200 | 50 |
| 100 | 10 |

## Europe As a Criterion

The only large region where white settlement has taken place for centuries is of course the continent of Europe. From all the European countries emigration has removed the surplus populations; and, though we cannot describe the continent as "saturated," it is the only one which approaches that condition.

In Figure 9 is shown the theoretical distribution of population in Europe by isoiketes compared with the present actual distribution. We see at once that

there is a strong resemblance between the isoiketes and the population lines. Both center about London from whence they form concentric loops about an axis reaching to Western Siberia. The 100 isoikete agrees quite closely with the 10 population line if the latter be inserted between the 2 and 26

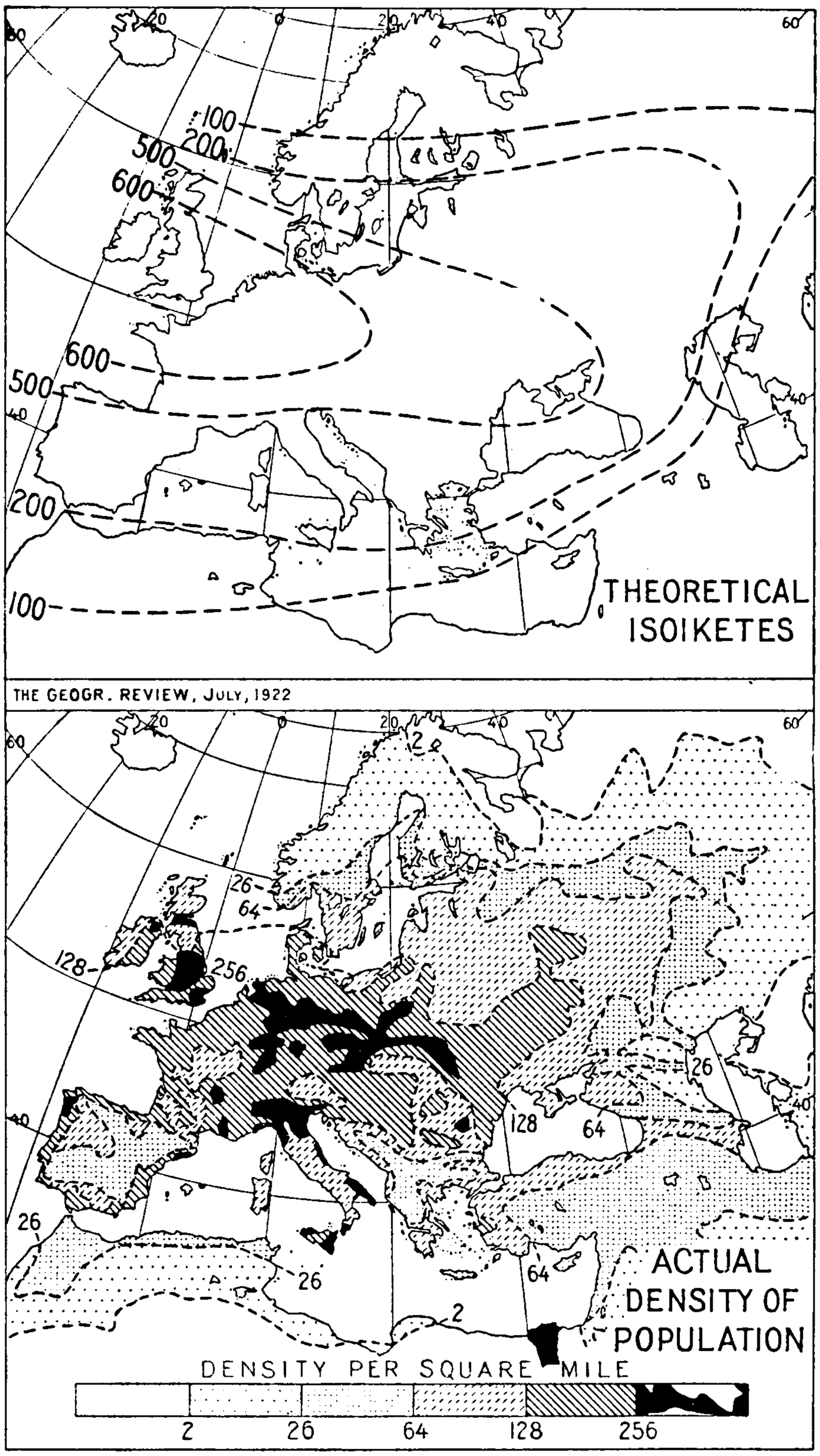


FIG. 9—The actual population density of Europe compared with the theoretical isoiketes (lines of "habitability").

lines. In the same way the 200 isoikete agrees fairly with the 50 population line, if it be inserted. The 500 isoikete is near the 150 population line, and the 600 isoikete is not far from the 200 line except in Galicia.

Plotting on a graph the European density of population and its corresponding isoikete, we can interpolate for the regions of moderate habitability, which do not occur in Europe. This gives us Table VII.

Using these factors we can arrive at a probable answer to the question,

"How will the white population of the world be distributed when the empty continents are occupied to the extent that Europe is at present?"

## Conclusions

### Distribution of Population

Using the ratios indicated in Table VII, we may hazard an estimate of the white populations which will cluster around the five world centers of Chicago, London, Sydney, Buenos Aires, and Durban. When the surrounding region shall have reached the condition of western Europe (with a density exceeding 100 per square mile) we may expect populations of the order given in Table VIII.

Table VIII—Potential Populations in the Chief Areas of White Settlement

| Region (Fig. 1) | Area in Square Miles | Estimated Density per Square Mile | Total Population |
|---|---|---|---|
| *North American Regions* | | | 702 millions (52%) |
| Northeastern states | 747 x $10^3$ | 400 | 298 |
| Inland plains | 592 | 200 | 118 |
| Alberta | 630 | 100 | 63 |
| Utah | 250 | 100 | 25 |
| Southeastern states | 486 | 100 | 48 |
| Eastern Canada | 960 | 100 | 96 |
| Oregon | 246 | 100 | 24 |
| Adjoining regions | | below 100 | 30 |
| *European Regions* | | | 386 millions (29%) |
| Britain | 120 x $10^3$ | 500 | 60 |
| Franco-Prussia | 422 | 300 | 126 |
| Poland, etc. | 400 | 200 | 80 |
| Adjoining regions | | below 100 | 120 |
| *South American Regions* | | | 115 millions (8.5%) |
| Uruguay, etc. | 750 x $10^3$ | 100 | 75 |
| Adjoining regions | | below 100 | 40 |
| *South African Regions* | | | 82 millions (6%) |
| Natal | 140 x $10^3$ | 100 | 14 |
| Rhodesia | 1,250 x $10^3$ | (40) | 50 |
| Adjoining regions | | below 100 | 18 |
| *Australian Regions* | | | 62 millions (4.5%) |
| Victoria | 172 x $10^3$ | 180 | 29 |
| Eastern coast | 98 x $10^3$ | 180 | 18 |
| Adjoining regions | | below 100 | 15 |

The total of these regions is 1,347,000,000. Distributed according to political control we have 377,000,000 (28 per cent) in the British Empire, 513,000,000 (38 per cent) in the United States, 457,000,000 (34 per cent) in other countries.

## Conurbations

Assuming that an adequate food supply is forthcoming, we may briefly consider how these vast populations will settle in the five major areas.

Professor Geddes, who looks forward to a period of more orderly design, has pointed out that in the British industrial regions the cities at present merge into great "disorderly conglomerations."[14] In England, for instance, there are two great clusters, "Greater London" and what he terms "Lancaston." The latter, extending from Liverpool to Leeds, is already 100 miles wide. He points out that five other conurbations are arising. These are the Scottish center (Glasgow-Edinburgh), the Newcastle center, the Sheffield center, the Birmingham center, and the South Wales center.

Lille and Essen are two continental examples which in the near future will unite via Antwerp and Liége. The Pittsburgh district is a forecast of the intense settlement which will arise in the eastern United States. Even in Australia the rise of such towns as Cessnock (4,000) within the last few years points to a conurbation around Newcastle. This will unite with Sydney and spread down the coast to the great Bulli coal field.

## Food Supply and Population Increase

Where is the food coming from to feed these industrial centers? Most people know of the huge granaries of Russia, the United States, India, etc., but fail to realize that already their huge populations permit of only limited export—before the war only about one-sixth of the total wheat production of each of these countries was exported (Table IX). Canada, Argentina, and Australia are exporting considerable percentages at present; but how long can this be maintained in the face of their own growing populations?

Table IX—Chief Wheat-Exporting Countries, Average Production and Export 1911–1913*

(*In millions of bushels*)

| | Production | Export |
|---|---|---|
| Russia | 727 | 128 |
| United States | 705 | 116 |
| Canada | 229 | 111 |
| Argentina | 156 | 101 |
| India | 370 | 60 |
| Rumania | 88 | 54 |
| Australia | 89 | 52 |

* G. B. Roorbach: The World's Food Supply, *Annals Amer. Acad. of Polit. and Soc. Sci.*, Philadelphia, Vol. 74, 1917, pp. 1–33. See also J. Russell Smith: The World's Food Resources, New York, 1919.

It has been estimated that before the war the United Kingdom and Belgium produced only 53 per cent and 57 per cent of their respective food requirements. To a less degree Germany and even France were dependent on outside sources. The closely settled regions of the East—India, China

[14] Patrick Geddes: Cities in Evolution, London, 1915.

and Japan—also are already anxious as to future food supplies. It is indeed a vital problem for the world as a whole and is of more immediate interest than most people realize.[15]

Let us consider the North American region of settlement with its potential 700 millions. The population of the United States has been doubling itself approximately each thirty years during the last century. It was 25 millions in 1850, 50 millions in 1880, and 100 millions in 1910. If this rate of increase continue, it will have grown to 700 millions in less than 100 years!

The world as a whole has doubled its population during the last ninety years. If the rate for North America drops to this figure, then it will take about 270 years to reach 700 millions.[16]

If we consider the time which it will take the Australian population of 5 millions to grow to 62 millions we find that it amounts to 100 years on the more rapid rate—which obtains at present—and to 320 years on the slower rate. These are much the same periods as deduced for the United States.

The Commonwealth Statistician (G. H. Knibbs) concludes his voluminous report on the 1911 census with the following pertinent remarks (p. 455):

> The earth's population may be taken . . . as 1,500 millions and its land area (excluding Polar regions) at 33,000 million acres. If we could raise 22.8 bushels of food corn per acre per annum, the total yield would only be 752,400 million bushels. The food consumption (per person) per annum is about equivalent to 5.7 bushels—which on the above computation would feed 132,000 million people.
>
> At the rate of increase of population of 0.01 per annum (somewhat less than the rate for all countries which have accurate statistics), it would require only 450 years to exhaust the food requirements mentioned. . . . The fundamental element in Malthus' contention is thus seen to be completely established.

I have shown what I deduce to be the distribution of the white peoples during the next two centuries. According to it we may expect an increase of 600 millions gradually to occupy North America; 100 millions in South America, and over 50 millions in southeastern Australia and also in South Africa. The future of the Indian and colored races I have not attempted to discuss in this paper. Already they amount to over 1,000 millions, and one can hardly estimate their increase in numbers in two centuries; for with the spread of sanitation and of law and order the natural increase of population throughout Africa and Asia is not likely to diminish.

Yet a general decline in the birth rate would seem to be the only answer to the statistical argument which I have quoted. It is difficult to imagine a crop (at present unknown) more valuable than wheat, and covering every acre of land surface. A vast world struggle between higher civilizations with a low birth rate and lower civilizations with a high birth rate seems to be foreshadowed. This would seem to be inevitable within the next two centuries if the white race is to maintain its dominant position.

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[15] On the general problem see M. Aurousseau: The Distribution of Population: A Constructive Problem, *Geogr. Rev.*, Vol. 11, 1921, pp. 563–592.

[16] Compare E. M. East: The Agricultural Limits of Our Population, *Scientific Monthly*, Vol. 12, 1921, pp. 551–557.

# MILITARY METEOROLOGY*

By WILLIAM GARDNER REED
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Since very early times the influence of the weather on military operations has been of great importance, and success or failure has many times been the direct result of weather conditions. But, because the scientific application of meteorology and its organization on a comprehensive scale are of recent development, modern military meteorology had its origin in the late war.

In the summer of 1917 it became evident that meteorological personnel and equipment were required by the American Expeditionary Forces in France. The interest of American meteorologists was aroused,[1] and arrangements were made to provide for the meteorological needs of the American armies in the field. Ideas as to the part meteorology played in the prosecution of war and as to the duties of meteorological personnel were, however, still very hazy, and actual work with the French and British armies was necessary to show how the meteorological units functioned. The actual day-to-day work began in April, 1918; and from that time until some months after the Armistice the meteorological work of the French, British, and American armies was carried on with cordial co-operation and mutual understanding. This account is an attempt to record some of the lessons learned.

## THE MILITARY FACTOR

The military side of military meteorology cannot be neglected, although this phase of the matter, which looms so large in actual experience, can here have only passing attention. The reason for speaking of it here is that it is of vital importance in the selection and assignment of meteorologists for active military duty. Unless the meteorological officer in the field can handle his men, procure quarters and food for them, get his equipment, secure communication and transport service, and in general fit himself and

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* It is a pleasant duty to acknowledge my great obligation to Lieutenant Colonel William R. Blair, Signal Corps, U. S. A., Officer in Charge, Meteorol. Sect., Sig. C., A.E.F., under whose command and guidance I studied and practiced military meteorology in France and Germany in 1918 and 1919. I also acknowledge the assistance of the other officers and the enlisted men of the Meteorological Section.

[1] Several papers dealing with phases of military meteorology and with the meteorological service of the United States Army have appeared from time to time in the *Monthly Weather Review*. Reference may be made, for instance, to R. A. Millikan: Some Scientific Aspects of the Meteorological Work of the United States Army, Vol. 47, 1919, pp. 210–215; B. J. Sherry and A. T. Waterman: The Military Meteorological Service of the United States During the War, *ibid.*, pp. 215–222; H. G. Lyons: Meteorology During and After the War, *ibid.*, pp. 81–83. See also M. M. Welch: Recent Publications Relating to Military Meteorology, *ibid.*, Vol. 46, 1918, pp. 40–41.—EDIT. NOTE.

his command into the tactical organization with which he is associated, no amount of ability as a meteorologist will avail anything. Furthermore, he must understand the methods and problems of the officers charged with the development of the tactical situation or he cannot make his services as a meteorologist count in the prosecution of the war.

From a tactical point of view it is probably desirable to divide military meteorology into that applying to permanent positions, for instance coast defense commands, and that applying to mobile armies, best exemplified by an expeditionary force on foreign soil. The meteorological problems, however, are not widely different. The general problems of military meteorology are best exemplified by the requirements of an expeditionary force; because, while the meteorological problems of such a force can readily be applied to fixed positions, the conditions under which an expeditionary force operates, or is likely to operate, set limits to the methods employed.

Military meteorology falls into three rather clearly defined parts:

1. Statistical information, or past weather.
2. Current information, or present weather.
3. Forecasts, or future weather.

## Statistical Information

Statistical information includes the mass of meteorological data which may be available for the region in question. Such information is valuable in connection with many military installations of a more or less permanent character and with the distribution of *matériel* and personnel, whether among training stations or on the battle front. In connection with statistical meteorology it may become necessary in the case of an expeditionary force to procure the information desired indirectly from observations on the character of plants, stream courses, etc. When an expeditionary force is being organized the meteorological officers attached to this force should accumulate as much information as possible regarding the conditions in the regions to which the force is to be sent. It is a question just how many data should be carried into the field. Field conditions do not readily lend themselves to transportation of voluminous records. On the other hand, the accumulation of material at the base in the home country is not of great value, owing to the fact that communications between the home base and the expeditionary force are apt to be overcrowded, and therefore the material accumulated is not readily accessible to officers in the field.

Statistical meteorology should be studied to such an extent that the meteorological officers can give definite information with regard to the important questions which are likely to arise. These questions will certainly concern such matters as the clothing and equipment of troops necessitated by the usual meteorological conditions. Extreme conditions are of less importance because a considerable amount of suffering by men and animals and serious disarrangement of transport by possible but not very probable

conditions must be expected in the case of any such expedition. The necessary preparation for expectable conditions will usually require all the energy of the general staff and impose such a strain upon communications with the home base that additional equipment to provide for unusual though possible conditions is not likely to be considered. Statistical meteorology will give such information as the probability of snow cover and the extent of such cover, the time of loss of leaves from trees or the changes in color of leaves, and similar matters of equal importance in these days of camouflage. It will show the time of freezing of rivers, important from the point of view of navigation and water supply as well as from that of transportation upon the ice. The probability and times of occurrence of snow and mud conditions with the resulting necessities of radical changes in transport methods will be shown by a proper study of the statistical records.

Before the medical department of an expeditionary force can make adequate arrangements for the care and transportation of the sick and wounded, or determine the number, design, and location of hospitals and the character and quantity of medical supplies, an adequate knowledge of the climate is required. While it is probably true that modern medical science has rejected the older ideas of climatic diseases, it is certain that weather conditions have an important effect on many types of disease; and weather knowledge is essential if the hospital rate is to be kept low and if the hospital facilities are to be adequate for the requirements.

Statistical meteorology is of particular importance in determining sites for the location of airdromes. After aircraft are in the air they can usually take care of themselves, subject of course to certain dangers which, however, are practically all less serious than enemy fire. The greatest difficulty in connection with aircraft comes in the take-off and the landing. Wind speeds which can readily be negotiated by planes in the air will cause serious crashes if they occur while planes are leaving the ground or alighting. Statistical meteorology can give valuable information in connection with the occurrence of such winds. As the control of a considerable part of these winds is topographic, a difference of a few miles in location may make an airdrome, considered as a harbor, relatively safe rather than dangerous. The direction from which dangerous winds come may indicate the proper orientation of hangars and buildings in order that they may be relatively safe.

Another point to be considered in the selection of the location for an airdrome is the occurrence of fog. Fog over an airdrome usually entirely obscures it from above and makes landing difficult and dangerous. Statistical meteorology can be of particular benefit by determining the positions where such fogs are least frequent. As the dangerous fogs are most often of the radiation type, the selection of hills which extend upward through the usual fog is indicated for the location of airdromes. Such hills, of course, should not be high enough to have dangerous wind velocities and, at least as far as airdromes within range of enemy artillery are concerned, should

not be distinctive landmarks, as these offer excellent targets. The dangers of the occurrence of fog vary with the type of airdrome. For instance, morning fogs, the usual radiation type, are probably most dangerous to night-bombing squadrons, as night bombing is usually undertaken on clear or partly clear nights and the planes wish to return home as late as possible, that is at just the time when radiation fogs are most likely to occur. Airdromes for day bombardment groups do not need such careful location with reference to fog conditions, although it is desirable to avoid them as far as practicable. The possibilities of locating airdromes for observation, reconnaissance, artillery adjustment, pursuit, and combat groups are more limited, because these airdromes must be nearer the lines than those for bombardment groups. However, the meteorological officer should be able to give information that would lead to the selection of the best one from a number of possible locations. Furthermore, as the lines are advanced it is a great convenience if the airdromes of combat groups can be occupied successively by artillery adjustment, observation, and bombardment groups.

The distribution of *matériel* and personnel within any zone of military operations is controlled to some extent by the meteorological characteristics of the zone as shown in the records of the past weather. It is known to every one that the distribution of clothing, food, shelter, heat, and light is so controlled. The record of prevailing winds by months is probably the best available guide for the concentration on certain parts of the battle front of chemical warfare troops and *matériel*. The position of gas shell dumps needs especial attention in this connection. Light data, the time of moonrise and moonset, of sunrise and sunset, and the duration of twilight have been found of value by searchlight units, anti-aircraft artillery, and night-bombing air squadrons in the distribution of lookouts and other personnel and in preparations for activity.

In addition to the service that statistical meteorology can render to other arms of the expeditionary force, the service it can render to the meteorological organization itself should not be overlooked. In order to provide the necessary information, proper sources for obtaining these data must be assured. Different arrangements must be made in different regions; if the expeditionary force is to operate in a friendly country with an organized meteorological service which can be counted on to supply information for the back area, it will not be necessary for such a force to operate as large a service of its own as it must when operations are carried on in a hostile country or one poorly provided with meteorological stations. Furthermore, the number, frequency, and location of meteorological stations will be governed to a considerable extent by the climatic conditions of the region in which operations are to be carried on.

## Current Information

Current information consists of various types of data for use by all operating units, including especially aircraft, artillery, chemical warfare, and

sound-ranging units. Information for aircraft consists of wind data for levels at which planes are likely to fly or in which captive or dirigible balloons may be used. Such data are becoming increasingly important as aerial navigation is developed, and allowance for drift of airplanes must be made. The meteorological officer with current information regarding winds at various levels in his possession can advise flying officers of the most satisfactory levels at which flights between designated places should be made. Another type of information of value to aircraft is the altitude of the clouds.

In the case of artillery the temperature, pressure, humidity, and movement of the air to the height reached by a projectile in flight are needed in correcting for the effects of these elements when laying the guns. Air density is a function of the first three elements; within limits air viscosity varies rather directly with temperature, but corrections for this variation are small, although appearing in the firing tables. It should be stated parenthetically that the firing tables contain corrections for powder temperature, but this should be determined by a thermometer exposed in a charge because powder temperature does not in general vary with air temperature. Possibly the most important meteorological conditions affecting the projectile are those which are known as "ballistic winds." Meteorological conditions begin to act on the projectile from the moment it leaves the gun and continue to act until it lands. The effect of variations from standard conditions in any layer of air is proportional to the time the projectile spends in that layer, provided it passes twice through it; that is, when the target is at approximately the same level as the gun. When the target is to be reached before the projectile arrives at the highest point of the trajectory, as is usually the case with anti-aircraft targets, the effect of any layer is proportional to the time the projectile spends in it and to the time of its travel from this layer to the target.

In the case of ordinary artillery the importance of the upper layers of air is evident when it is considered that a projectile spends half its time in the upper quarter of its trajectory. In practice the air through which a projectile passes is divided into layers which are considered separately, weighted with the proper factors, and then combined for the total height of the trajectory. From this combination a single artificial wind direction and a single artificial wind speed affecting the projectile are computed and given to the artillery as a ballistic wind. This ballistic wind represents the total effect of the wind on the projectile from the moment it leaves the gun until it lands or bursts. Speed is essential in the computation of ballistic winds in order that the artillery may have this information while it is still valid and before conditions have perceptibly changed. In practice it has been found that observations once in four hours are usually sufficient.

A development of the World War was the accurate determination of the location of enemy guns from the rate and direction of the travel of sound.

It has been found by experiment that this is affected more by the air movement at about one hundred meters above the earth's surface, than that at higher or lower levels; it is also affected by the temperature and humidity of the air; these observations must be furnished promptly to the sound-ranging units if such units are to operate with the maximum of efficiency.

Current information enables the medical officers to make more effective plans for their work. For instance, weather which tends to keep men in billets or barracks increases the hospital rate. During the occupation of Coblenz the influenza rate could be forecast from the temperature, cold weather causing the men to stay indoors with the resulting spread of infectious diseases. The current weather information will give medical officers time to prepare hospital facilities and enable them to foresee the demands which will be made on them; this will permit the accumulation of adequate medical personnel and supplies at the points of greatest need. For example, wet weather with temperatures at or below freezing will greatly increase the sick rate of men in trenches, and preparations for the treatment of frostbite, trench feet, etc., can be made so that cases may be treated as they come in.

## Station Equipment and Reports

The equipment consists of the ordinary station instruments, together with pilot balloon equipment for observing the movement of the upper air, which must be known up to the highest levels reached by aircraft or by projectiles. Owing to the conditions under which military stations must operate, the strongest type of equipment is required in order to prevent excessive breakage. It is, of course, obvious that stations operating in the neighborhood of artillery or in places likely to be shelled or bombed cannot depend upon aneroid barometers, as these instruments are damaged by concussion. In the case of a direct hit the equipment will be destroyed; replacement equipment must therefore be available at not too great a distance.

Conditions at forward positions make it necessary to take pilot balloon observations with one theodolite, although two or even three theodolite observations doubtless make for greater accuracy. It is often difficult enough to find one theodolite position sheltered from enemy observation—where observation means destruction whenever the enemy is so minded—and there is practically no possibility of finding two such positions within sight of each other and of providing the necessary equipment for communication between them. In this connection it is desirable to note that all units operating under control of the expeditionary force should be interchangeable, that is it should be possible to replace a front line unit with the one from the rear; therefore differences in method for different locations are inadvisable. Furthermore, meteorologists with actual experience in the area of military operations are of the opinion that two single theodolite observations

from different locations are worth more than a double theodolite observation at one location, although the latter may be somewhat more accurate.

In connection with supplying ballistic winds to artillery and actual winds at various elevations for the air service it must be remembered that the artillery may fire through clouds and that it may be necessary for airplanes to fly through and above clouds. The unit making the meteorological observations has the most information upon which to estimate conditions when direct observations are impossible. Air movement in and above clouds may be determined by the methods of "sounding by sound," which in brief consist in sending a bomb aloft by a balloon and bursting it at a height approximately determined. The exact position in space at which the burst occurs can be determined by sound-ranging methods, and the exact height and the horizontal drift of the balloon from the time of release to the time of the explosion of the bomb can be computed. When such information is not available an alert meteorological observer can secure information which will enable him to estimate conditions with considerable accuracy. During cloudy weather he should watch for breaks in the clouds and attempt to get a balloon through these breaks even though the time for a regular observation has not arrived. Anti-aircraft guns may be fired through breaks in the clouds, and the drift of the smoke from the burst may be followed with a theodolite. The drift of clouds may be observed and the approximate height estimated. All reports from neighboring stations, friendly or enemy, should be recorded; as ballistic winds are usually sent to the artillery by radiotelegraphy, enemy information can be obtained if the meteorological observer takes pains to ascertain the times of sending and the wave length. His own equipment will enable him to receive the messages, and if the intelligence service of his army cannot provide him with the code used his ingenuity will enable him to work it out. From these miscellaneous data a successful estimate may be made. The firing tables issued to the artillery provide for meteorological data, and some value must be used for this term.

## Weather Forecasting

Military forecasting should not be essentially different from any other sort of forecasting. Successful forecasting for the staff officers charged with the control of operations does, however, depend on an appreciation of their problems by the officer making the forecast. A forecast for military operations should be stated as concisely and definitely as possible; in fact, it is best to make direct positive statements of the future weather. Operations officers must take chances with many elements of which the weather is only one; what they require is the best estimate of the situation and some idea of the accuracy of the estimate. It is far better to state positively what the weather will be and to follow the definite forecast by a statement that the chance of its being correct is ten to one, five to one, or three to one, as the case may be.

Special forecasts may be made for all sorts of special operations. For example, the offensive use of gas requires detailed forecasts of local air movement in restricted localities; this often calls for special observations in detail at frequent intervals. The artillery frequently find it advisable to institute firing programs at particular times, such as dusk or dawn; the meteorological service will frequently be called upon to make special forecasts of visibility for these programs. Forecasts of the character of the night, whether clear, cloudy, or with broken cloud, are particularly important in planning offensive bombing operations by aircraft or in arranging for defense against possible enemy raids. For instance, if the conditions on the Lorraine front in the fall of 1918 indicated a moonlight night with broken cloud and a moderate west wind at reasonable flying levels, an enemy raid was practically certain and could be forecast with great accuracy; furthermore, with a little knowledge of the enemy's habits together with observations of his aerial activity during the preceding day, the point of the raid could generally be forecast.

In forecasting for an expeditionary force it is obvious that there is likely to be little opportunity for dependence on weather types and hence for empirical forecasting based on the resemblance of the current map to a type in the files. In his home country the forecaster is in touch with the maps of past years; all meteorological services have built up files of maps and in many cases have selected type maps which may be and usually are used, consciously or unconsciously, by the forecasters. In a region new to the forecaster this procedure is far from convenient and often impossible. Furthermore, the possibility of military activities in a region without published maps must be considered.

With the advance from empirical to rational methods in forecasting, this is not so great a difficulty as might appear. There can be little doubt that the future weather is the result of physical and dynamic processes which are going on currently, and current meteorological information and that of the immediate past should furnish all the data necessary for a proper forecast. It is a question whether forecasting has as yet reached a stage where this is possible, but experience with the American Expeditionary Forces in France and Germany leads to the belief that forecasting, at least for an expeditionary force, should be on this basis. Such a point of view, of course, lays more emphasis on theoretical physics than upon weather types and requires fundamental training in meteorological physics and the dynamics of fluids rather than experience in forecasting in the home country.

## Distribution of Stations

The number and distribution of the stations operated by the meteorological service of an expeditionary force will depend upon many factors. In the back area the number will probably be about the same as would be required for peace-time meteorological information; if there is a suitable meteorologi-

cal organization already in this area its stations may well be used. It will probably be necessary to add a few stations at special points, such as artillery and other training fields and airdromes. The stations in the back area should serve for training meteorological personnel and supplying information to the military units stationed in this area as well as for making the fundamental observations upon which the forecasts are based. In the area of military activity there must be a greater density of stations. There should be at least one station in each region where airdromes are located, and stations to supply ballistic winds to the artillery and information to the sound-ranging and other services must be located along the front in sufficient numbers to give adequate information. The number will not be the same in different regions but will to some extent be governed by the general climatic conditions.

Furthermore, it has not yet been found practicable to operate a military meteorological service solely on the basis of the meteorological conditions encountered. Practical problems of tactical organization make it desirable that the meteorological units bear a rather definite relation to the tactical divisions by which the army operates. Perhaps the most usual and satisfactory organization is that of a first-class station completely equipped for all observations and for weather-forecasting attached to each field army. This station should be in close touch with the army headquarters and should have telegraphic communication with the stations in the back area to provide it with the information necessary for forecasting. In addition to the forecasting station in the army area, it will be found desirable to establish from two to five or more stations in the same area to serve the artillery and other units. Inasmuch as tactical considerations play a very important part in the organization of the army area, the most convenient arrangement appears to be the assignment of one of these substations to each army corps. The conditions existing in the particular region will undoubtedly serve to modify the general plan; but if equipment and personnel are provided for a first-class forecasting station attached to army headquarters and an observation station equipped for surface and upper air observations for each army corps, it will be possible in nearly all cases to provide the forward area with an adequate meteorological service. The back area is a regional problem and from a tactical point of view must be handled in much the same manner as the lines of communications of the armies.

# MONSOON AND TRADE WINDS AS RAIN MAKERS AND DESERT MAKERS

By ALEXANDER MCADIE
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Much has been written about monsoons, but it must be confessed that it is difficult to follow the explanation of these winds given in most textbooks. One reads, therefore, with great relief the simple, straightforward exposition of the southwest monsoon of India[1] given by the new Director of the British Meteorological Office, Dr. G. C. Simpson, long connected with the Indian Meteorological Service and well known for his work with Scott in the Antarctic.

The word "monsoon," most of us know, is from the Arabic and means season. Meteorologists now quite generally make an adjective of the word, to indicate a seasonal wind. More precisely it is a flow of air, directly associated with the northward or southward swinging of the great air streams—the trades and the prevailing westerlies. "Monsoon," however, has always been associated with rain, indeed copious rain. It is said that the military expeditions of Alexander brought back to Greece a knowledge of these rain winds and, presumably, the dependence of the harvest upon their early arrival. And so in India the word has come to mean the rainy season, from June to September.

## USUAL EXPLANATION OF THE MONSOON INSUFFICIENT

Now the usual explanation of the cause of the monsoon is that during summer the air over the interior of Asia (or other continents) is so much warmer than the air over the water (in this case the Indian Ocean, Arabian Sea, and Bay of Bengal) that an inflow occurs. This is also the explanation generally given for sea breeze. In neither case is the explanation sufficient. Dr. Simpson points out that India is much hotter in May, before the monsoon begins, than in July, when the monsoon is in full swing; and, what is the more suggestive, the hottest part of India, the northwest, gets no monsoonal wind or rain; and, finally, the temperature is higher in years of deficient rains than during good monsoons.

## MONSOONAL INFLUENCES ON THE CALIFORNIAN COAST

Furthermore, it must not be forgotten that often when there are moisture-laden winds blowing into a warmer region, rain does not fall. There must

[1] "The South-West Monsoon," *Quart. Journ. Royal Meteorol. Soc.*, No. 199, Vol. 47, 1921, pp. 151–172.

be rapid and sufficient cooling. This cooling may be brought about by various means; but chiefly it is accomplished by uplift and expansion. A good example of failure to produce rain occurs on our own Californian coast in midsummer. The prevailing west winds are essentially monsoonal in character and carry at least 10 grams of water vapor to every cubic meter of air. These winds blow steadily from late forenoon until after sunset, with an average surface speed of 10 meters per second. No rain falls; yet if only one-tenth of the vapor were condensed and one-tenth of this pre-

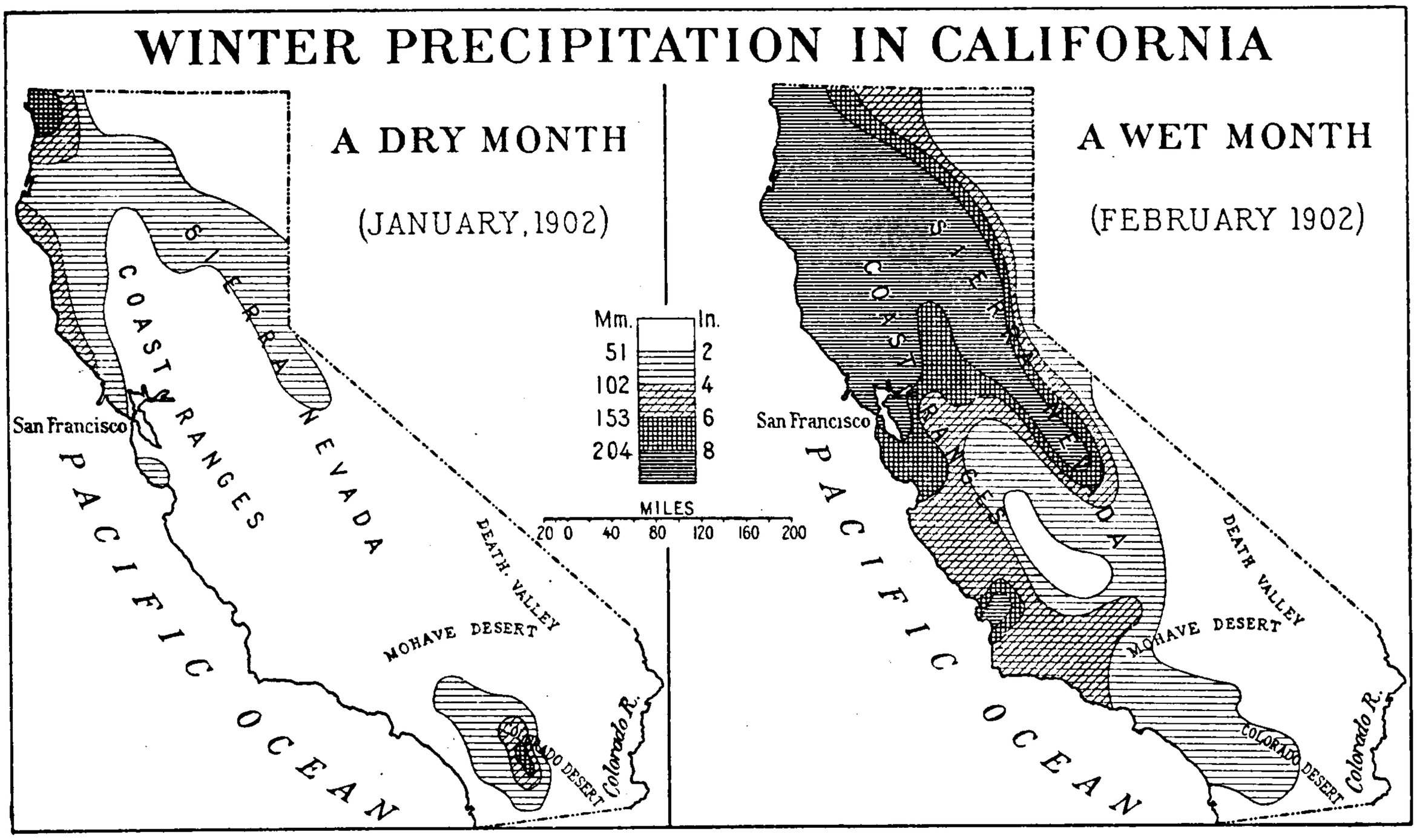


FIG. 1—Maps showing the distribution of total precipitation in California during dry (January, 1902) and wet (February, 1902) winter months. In the case of the former the precipitation amounted to approximately 24,000,000 tons of water; in the latter 150,000,000 tons.

cipitated, the rainfall would exceed five millimeters, or two tons to the acre per day.

The heavy fogs along the Californian coast show that the water vapor is present and can be condensed on a surface of lower temperature. There is, however, no rain, although the air stream must rise at least 2,000 meters in the comparatively short distance of 150 kilometers. The reason is that the air stream is flowing into a region of much higher temperature, and the mountains are rendered non-effective rain makers. But for this heating there would be heavy rainfall in summer just east of the crests of the Sierra and the Coast Range; and what is now largely desert would be a region bountifully supplied with water.

In a dry midsummer month very little rain falls in California. The storm paths have swung far northward, and the mountains are not able to rob the prevailing westerlies of even a small part of their load of water vapor. In such a month the total rainfall of California may not exceed 156,000 tons of water, or about one ton to the acre.

In a dry midwinter month, however, an occasional storm assisting, the mountains rob the air streams of much of the moisture; and even in an exceptionally dry winter the monthly rainfall will amount to 20,000,000 tons of water. During a wet winter month, chiefly because of the succession of storms from the north, the rainfall for the state may equal or even exceed 150,000,000 tons of water.[2]

## Complexity of Causes of the Monsoon in India

From what precedes we see that rain making, even where there is a strong and steady seasonal air flow, is not a simple matter. We fully agree with

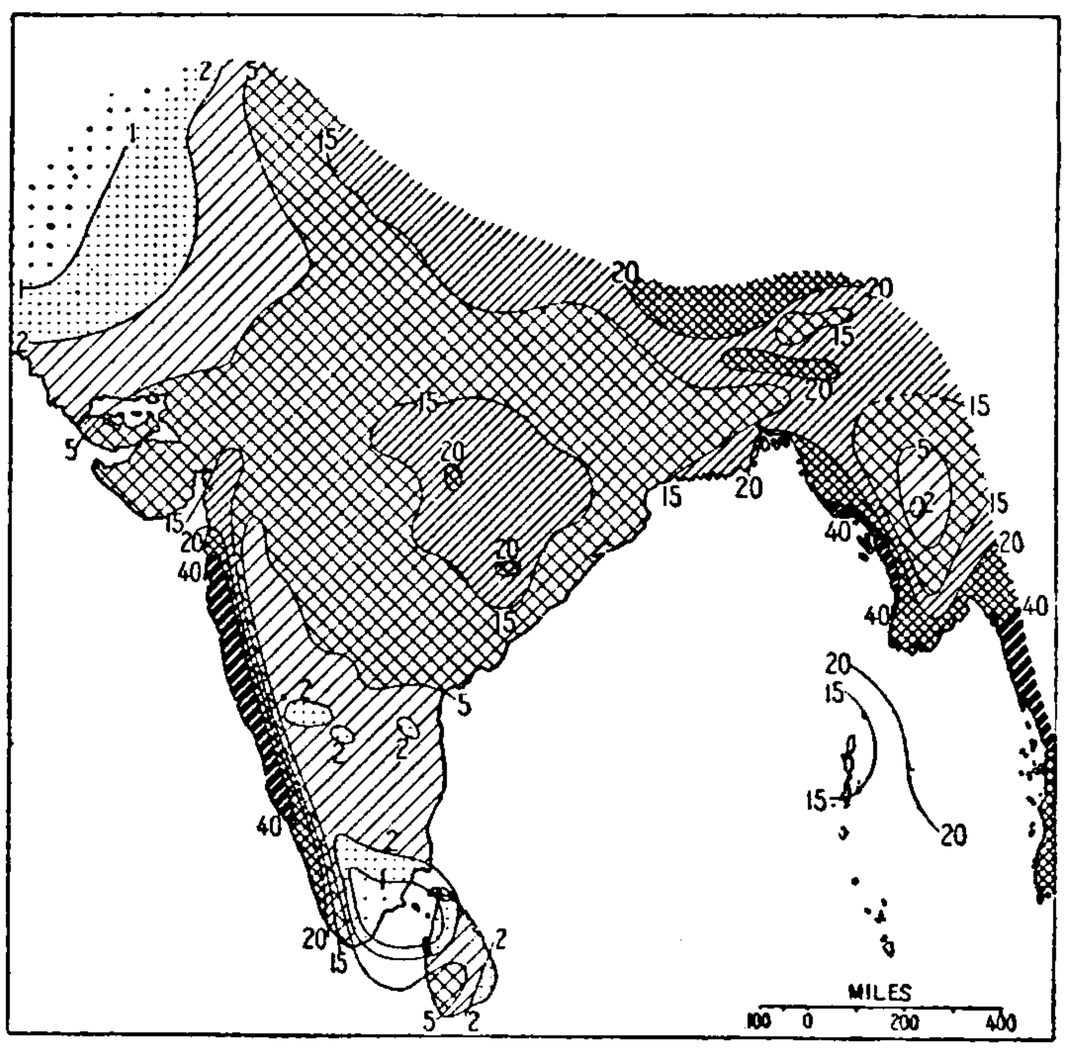


FIG. 2—Rainfall over India in July (after Simpson). Rainfall is in inches.

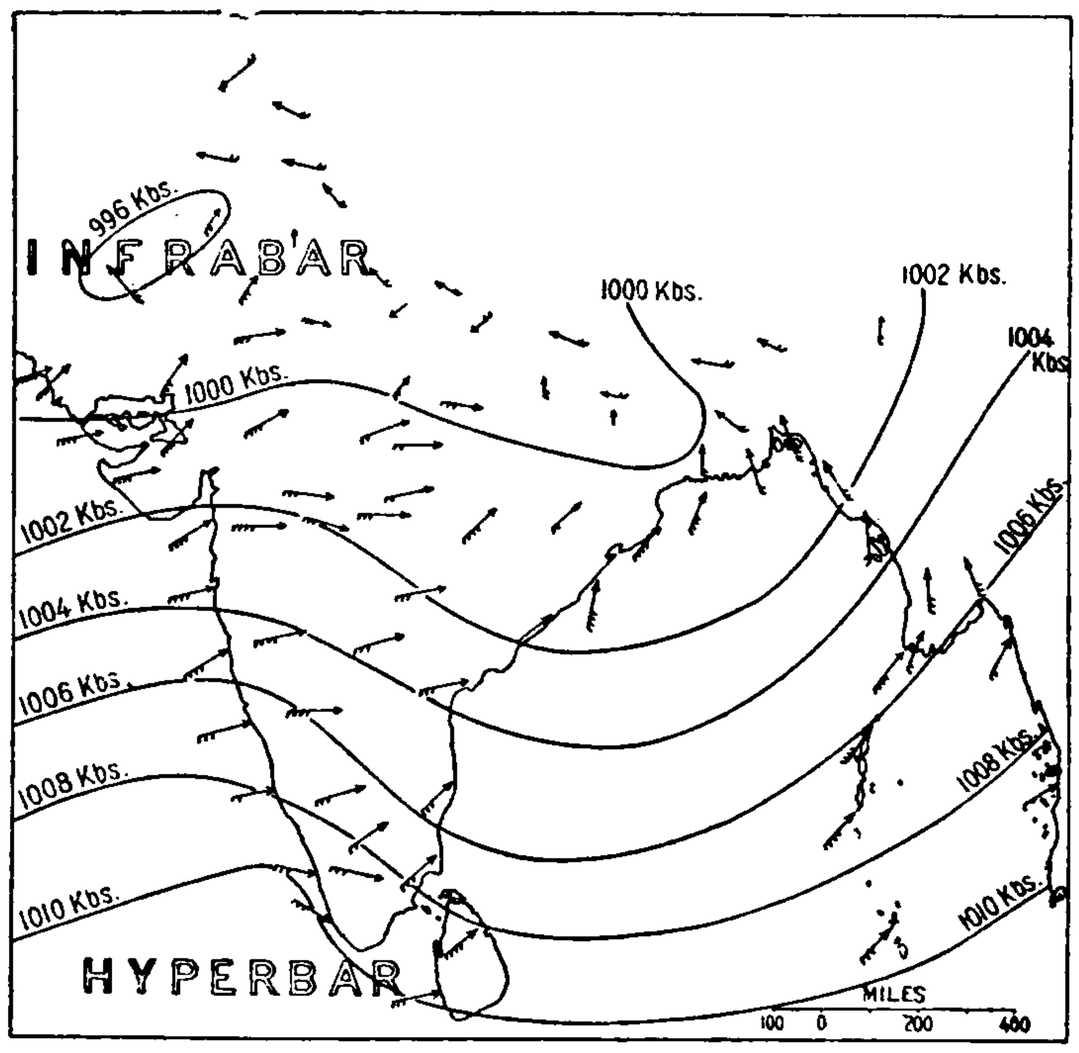


FIG. 3—Pressure over India in July (after Simpson). Pressure is in kilobars (1000 kbs. = megadyne atmosphere).

Dr. Simpson when he says that rain as dependent upon the monsoon or indeed the monsoon itself is

not the simple result of a single physical condition. It is produced by a combination of circumstances, involving consideration of temperature, pressure, humidity, geographical relationships between land and sea, the rotation of the earth, and lastly, but probably the most important, the distribution of mountain ranges.

There is no question but that the southwest monsoon of early summer is a rain-bearing wind *par excellence* for India. Dr. Simpson, in a series of maps showing pressure centers, air flow, temperature, and rainfall for the months of May and July, makes plain the sweep of the rain-bearing winds and the action of the mountains.

The air strikes the western coast of India almost at right angles; over the Bay of Bengal, traveling in a large circle, it impinges on the coast of southern Burma almost at right angles; to swing again, nearly parallel to the coast of northern Burma and then across deltaic Bengal, in a steady

[2] See the author's "Climatology of California," *U. S. Weather Bur. Bull. L*, 1903, and his "The Rainfall of California," *Univ. of California Publs. in Geography*, Vol. 1, 1914, No. 4.

current from the south. Air which crosses the coast of Bengal is deflected to the north soon after crossing and becomes a southeasterly or easterly wind along the foot of the Himalayas into the Punjab.

From a study of Figure 4 it is plain that the mountains stand as a box, or receiver, with two sides into which the air pours and that it must flow over the edges at an elevation of at least 2,000 meters—the minimum height of the mountain wall in the east (in reality the ascent is more nearly 6,000 meters). It is to this forced draft that India owes its rainfall: "the ascensional currents due to India being warm are absolutely insignificant in comparison."

The main currents from the south of the Arabian Sea (air streams I, II, and III in Fig. 4) strike the Western Ghats practically at right angles and are forced to rise vertically 1,500 meters. Now the air stream has traveled 7,000 kilometers over the ocean and has an average saturation of 90 per cent, with a mean temperature of 1,094 Kelvin kilograds (78° F.).[3] There are nearly 25 grams of water vapor with each cubic meter of air. One need not wonder, then, that the rainfall is very heavy in certain places. On the Western Ghats the amount is 1,270 millimeters (50 inches) in a month, or 182 tons to the acre per day—three times as much as we get on the northern coast of California in a winter storm.

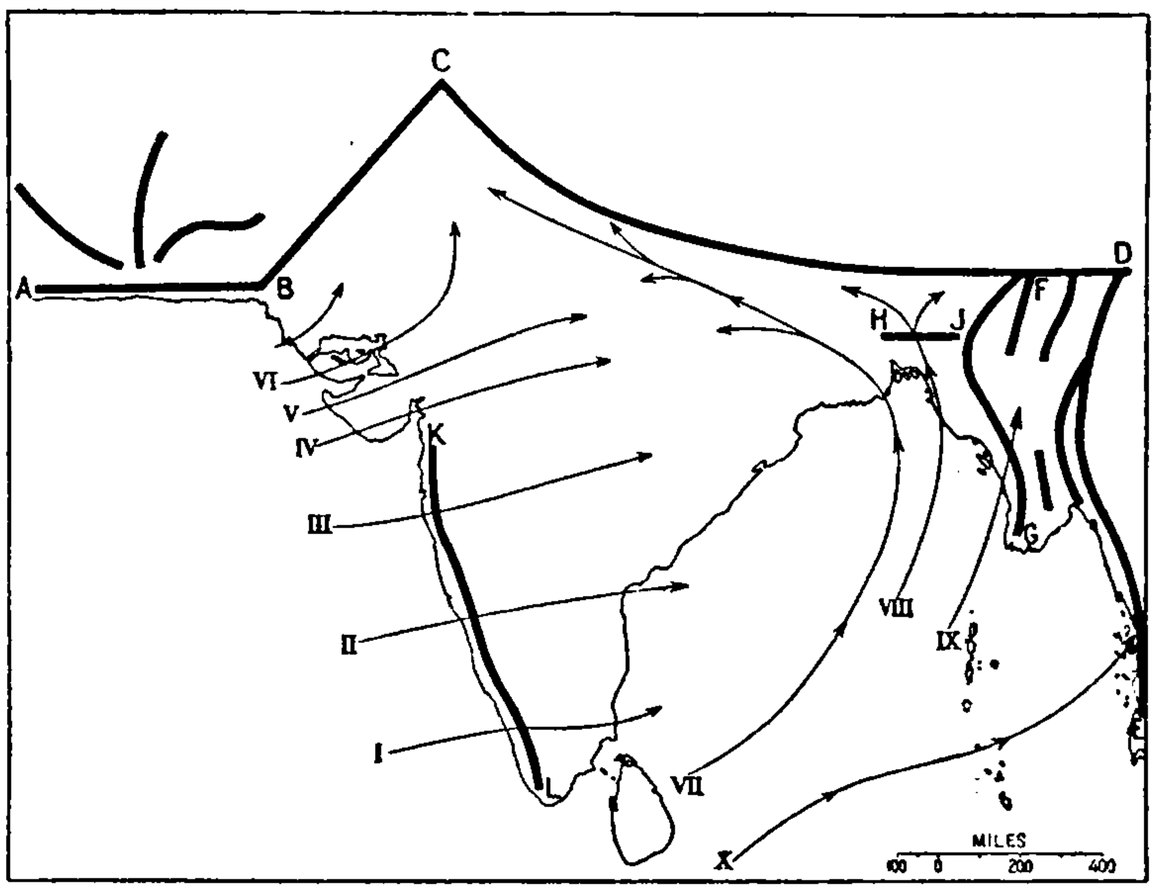


FIG. 4—Air stream lines during monsoon, showing relation to mountain systems (after Simpson).

The rainfall of Cherrapunji is generally said to be the heaviest in the world,[4] and we quote Dr. Simpson:

> The most interesting case is that of stream line VIII. The air in this current leaves the Bay practically saturated; it then crosses deltaic Bengal, which at this time of year is practically one great swamp—in fact a continuation of the sea, except that its water is fresh. This air current strikes the Khasi Hills, in Assam, at right angles. These hills near Cherrapunji present almost a vertical face to the air current, which has to rise almost vertically for 4,000 feet. Such a rapid rise through 4,000 feet of a warm saturated air current blowing with a velocity of many miles an hour causes heavy deposition of water which falls on the top of the hills with great intensity. The annual rainfall of Cherrapunji is 424 inches, the greatest recorded rainfall on the face of the earth, although there may be places in the Western Ghats where the rainfall is locally heavier. Practically the whole of this great amount falls during the monsoon.

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[3] In this scale of temperature zero is the absolute zero (−273.12° C., or −459.4° F.) and 1,000 is the freezing point of water under megabar pressure.

[4] However, this may not be the heaviest rainfall on the face of the earth. G. K. Larrison states that Mt. Waialeale, on the island of Kauai, Hawaiian Islands, with an elevation of 1,548 meters (5,080 feet), has an average annual rainfall (based on records for five years) of 12.09 meters (476 inches). From a study of records of near-by stations he thinks that in 1918 and 1914, in which years unfortunately the records were lost, the rainfall must have approximated 15.24 meters (600 inches) (*Monthly Weather Rev.*, Vol. 47, 1919, pp. 303–305). At Cherrapunji the maximum precipitation is supposed to have occurred in 1861, when 22.99 meters (905 inches) were recorded, but the record may be erroneous.

## Winds that Cause Deserts

But, if the winds can bring rain, paradoxical as it may seem they can also prevent rain from falling and in extreme cases can cause deserts. We now know from aerographical studies that, although warm moist air may be rising and cumulus clouds may be forming, a strong upper-air current may blow the clouds away and interrupt the process of rain making. Indeed, the most significant feature of Dr. Simpson's study of the monsoon is the conclusion that the dry region to the northwest of India is due not only to the barrier of the mountains and the deflection of the moist air currents but also to the existence of a dry upper wind, which, with warm air over the interior, prevents cooling and cloud building.

This arresting of the cloud-building, rain-making process by wind action is known to occur elsewhere. For instance, I. R. Tannehill, discussing the rainfall of the southern Texan coast,[5] shows quite clearly that the reason Corpus Christi has less summer rain than Galveston is because the strong southeast wind—the fresh breeze from the Gulf, essentially a monsoonal wind—interferes with the building up of summer cumuli and cumulo-nimbi. In other words, convectional processes go on along the northern coast of the Gulf but are interrupted on the southern coast.

## The Monsoonal Rain of India

To return to the problem of the efficiency of the southwest monsoon as a rain maker. Under the influence of the pressure distribution and the earth's rotation the air in the south of the Indian Ocean moves towards the equator in a northwesterly direction. Beyond the equator it passes into the circulation moving in a northeasterly direction, thus bringing moist air from the southern into the northern air system. The high vapor content of the monsoon comes with the great distance the air stream has traveled over warm water. It is only when the air passes from the southeast trade into the circulation controlled by the Asian infrabar that *enough* damp air reaches India to cause cloud and rain in sufficient amount to overcome any increase in temperature over the land and thus establish the monsoonal rain. Simpson shows plainly that the monsoon must be traced back beyond the Arabian Sea—much farther indeed—back to where the air stream recurves far south of the equator and becomes linked up with the southeast trade. The circulation controlling the monsoon may thus be likened to a gigantic letter S, the equator passing through the middle.

When the air flowing over the Arabian Sea is deflected to the right, and becomes a northwest wind instead of a southwest, then the season is a dry one in India; and it matters not whether the mountains are high or at what angle the ranges face the on-coming winds. Such a deflection may be caused in part by the earth's rotative deflecting force, but chiefly it is

[5] *Monthly Weather Rev.*, September, 1921, p. 498.

caused by a displacement of the Asian infrabar to the southeast. If at the same time the Indian Ocean summer hyperbar is shifted south, then there is less southerly wind, and the lower half of the gigantic S circulation practically disappears.

## Seasonal Rain on the Pacific Coast

The case is somewhat different on our Pacific coast. In an exhaustive paper on "Seasonal Forecasting of Precipitation—Pacific Coast" Professor A. J. Henry discusses three classes of seasonal rainfall and their probable causes.[6] The tables given are detailed, but the conclusions are best expressed in the addendum where he quotes two general laws deduced by the author of this article, with which he states his own findings are "in close accord."[7] These laws as quoted read

> A. When the continental HIGH [hyperbar] overlies Oregon, Idaho, Utah, and Nevada, the general drift of the surface air is from the north or northeast, and such a circulation favors fair weather, with little precipitation. . . . Individual LOWS are restricted to northern counties and pass eastward without extending southward.
>
> B. When the north Pacific low area (the Aleutian LOW [infrabar]) extends well southward along the Oregon coast and the continental HIGH overlies Assiniboia [now Saskatchewan] and Montana, the general drift of the surface air in California is from the south or southeast. Conditions (then) favor unsettled weather, with frequent heavy rains west of the Sierra and heavy snow fall in the Sierra. Individual HIGHS appear with little warning north and east of the Kootenai and move, as a rule, slowly south. Individual LOWS appearing over Vancouver Island and the north coast of Washington deepen and also extend southward, the rain area reaching Northern California in 12 hours, the central coast in 24 hours, and the coast south of Point Conception in 36 hours.

## Variation in Seasonal Rainfall and Its Prediction

The laws A and B were set forth in 1908 and, in the light of Dr. Simpson's work, can now be amplified by the addition of a third law:

C. A dry period in winter on the coast of California is caused by a deflection of the wind from southwest or south to west or northwest, due primarily to a retrogression of the Aleutian infrabar. Such winds blow parallel to the coast, have traversed but a short distance, and are moving from colder to warmer regions. The mountains of California cannot act as efficient condensers.

Conversely, heavy and frequent rains are due to long-distance air streams impinging as southwest winds on the coast. These streams may have had their origin as northeast trades which, recurving and working north, describe a semi-circular path of 6,000 kilometers and merge into the flow around the Aleutian infrabar, which extends far south. With an initial temperature of 1,090 kilograds (77° F.) and a final temperature of 1,040 (52° F.) the saturation weights have changed from 22 grams per cubic meter, or two pounds of water vapor with every thousand cubic yards of air, to a saturation

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[6] *Monthly Weather Rev.*, April, 1921, pp. 213–219.

[7] *Monthly Weather Rev.*, Vol. 36, 1908, p. 100.

weight of 10 grams, or one pound of water vapor. It is plain that the Coast Range, the Sierra, and the Cascades can *now* act energetically as rain makers, for a moderate uplift of the air streams gives sufficient cooling to produce generous rain.

A wet winter means much to California, for the water supply is all important; and provision must be made for the long rainless summer. Right in the heart of a rainy season there may come a dry period. This condition, which for a long time baffled explanation, is now seen to be due to an interruption of the circuit of the air stream over the ocean. This happens when air surges southward from the Yukon. Usually the flow is southeast and on the inner side of the Siskiyou and the Coast Ranges; but occasionally the polar front bulges southwest, and the ocean winds are forced seaward. At such times heavy snow falls on the immediate coasts of Washington and Oregon; but California for the most part is dry.

What the cause of these polar surges may be awaits explanation; but forecasters are everywhere awake to the significance of these south-directed tongues of Arctic air. Likewise the importance of a knowledge of the strength and shift of hyperbars and infrabars is appreciated, especially in forecasting seasonal rainfalls. The unprecedented drought in England during 1921 might have been successfully forecast.

The flow of air from the Atlantic was below the normal and instead of the usual frequent showers, there were long rainless months, with wind from the south. Anticyclonic conditions prevailed. C. E. P. Brooks, through whose persistent labors the network of world surface air data (*Réseau Mondial*) was made possible, shows[8] that during the period from February to June, 1921, a hyperbar with an excess of pressure equal to six kilobars (the whole atmosphere is 1,000 kilobars) was centered over England and northwestern France. An infrabar was centered near Spitsbergen and was fully six kilobars below normal. Hence there was a strong flow of dry air northward, into a region where, furthermore, temperature was considerably above normal.

How far-reaching the effects of these great displacements are is shown by the fact that the temperature over the central part of the United States during this period was from 10 to 16 kilograds above normal. Thus at Chicago the excess temperature was 16 kilograds (eight Fahrenheit degrees) and might naturally have given rise to the belief that the climate was changing. There was a change, but not a permanent one. The year 1921, in brief, was like 1911 when similar but less pronounced high temperature and low rainfall prevailed over Europe.

## Occurrence of Drought and Formation of Deserts

Finally, we seem to be about to discover a law connected with the occurrence of droughts and the formation of deserts.

[8] C. E. P. Brooks: Could the Drought of 1921 Have Been Forecasted? *Meteorol. Mag.*, September, 1921, pp. 211–215.

Two infrabars, the Icelandic and the Aleutian, extensions probably of a large subpolar sink, from time to time are displaced far south; and the hyperbars of the temperate latitudes swing south in company. Such movements make for strong southwest winds on our Pacific and the European Atlantic coasts, and rain falls easily. But, when the Icelandic and Aleutian infrabars lie far north of their normal localities, then we have high temperature, variable winds, and scanty rain. And these larger pressure areas apparently control the path, frequency, and intensity of the smaller pressure areas known as cyclonic storms. Also, and this is most important, they determine the length and strength of the great seasonal air streams, the trade winds and the monsoons, and thus control rainfall.

# CLEANSING NEW YORK HARBOR

By Sidney A. Reeve

For many years the pollution of the water of New York harbor has been very bad. The ejection of the city's sewage into the North and East Rivers, combined with some carelessness as to dead animals and some infraction of the law by the manufacturing industries, has led to a situation which is nothing short of a disgrace for the first city of America.

Within the last few years conditions have been made considerably worse by the transformation of many large ships from coal to oil burners. Heavy scums of waste oil have coated the water and even the river shores as far north of the city as the flood tide sets in and all of the beaches below the city inside of Norton's Point and Sandy Hook. The presence of this oil upon the water has led to at least one serious fire.

Meanwhile New York has advanced in rank from the first city in America to the first city in the world in financial importance if not in population. It is the port of entry for world travel towards the greatest of all world centers. That its harbor should be as dirty as it now is, has become a national disgrace.

The cleansing of the harbor has for some time been a matter of concern to several of our prominent citizens. The only outcome of their efforts, however, has been an attempt at better enforcement of existing laws. Since even a perfect enforcement of the laws would still leave the harbor polluted with sewage, which is really the worst of the features mentioned if not the one most offensive to the eye, it is worth while to consider whether measures might not be taken which would rid us of all sorts of pollution at once. For this could be accomplished by rinsing out the harbor twice a day with clean sea water, by tidal action controlled by suitable tidal gates.

## Natural Cleansing Effect of the Tides

In order that this possibility may be clear to the reader, reference should be made to the outline map of New York harbor and neighboring waters, Figure 1. The map shows the waters immediately surrounding Manhattan Island to be accessible to tidal action from the sea in two directions, namely: (1) from the south, through the Narrows, and (2) from the east, through Long Island Sound and Hell Gate. The tides entering by these two routes do so fairly simultaneously, giving rise to the tidal phenomena in the East River, as a result of which somewhat more water flows in a southwestwardly direction through Hell Gate, on the ebb, than passes in in the northeasterly direction on the flood. The slight difference in the time and force of the two tides results in the draining, on the ebb, of a small portion of the clean

sea water which had been sent in through Long Island Sound on the flood, out through the East, Harlem, and Hudson Rivers and thus out to sea through the Narrows.

At present this slight rinsing action is the only factor tending to cleanse New York Harbor of its pollution at all; for the amount of fresh water

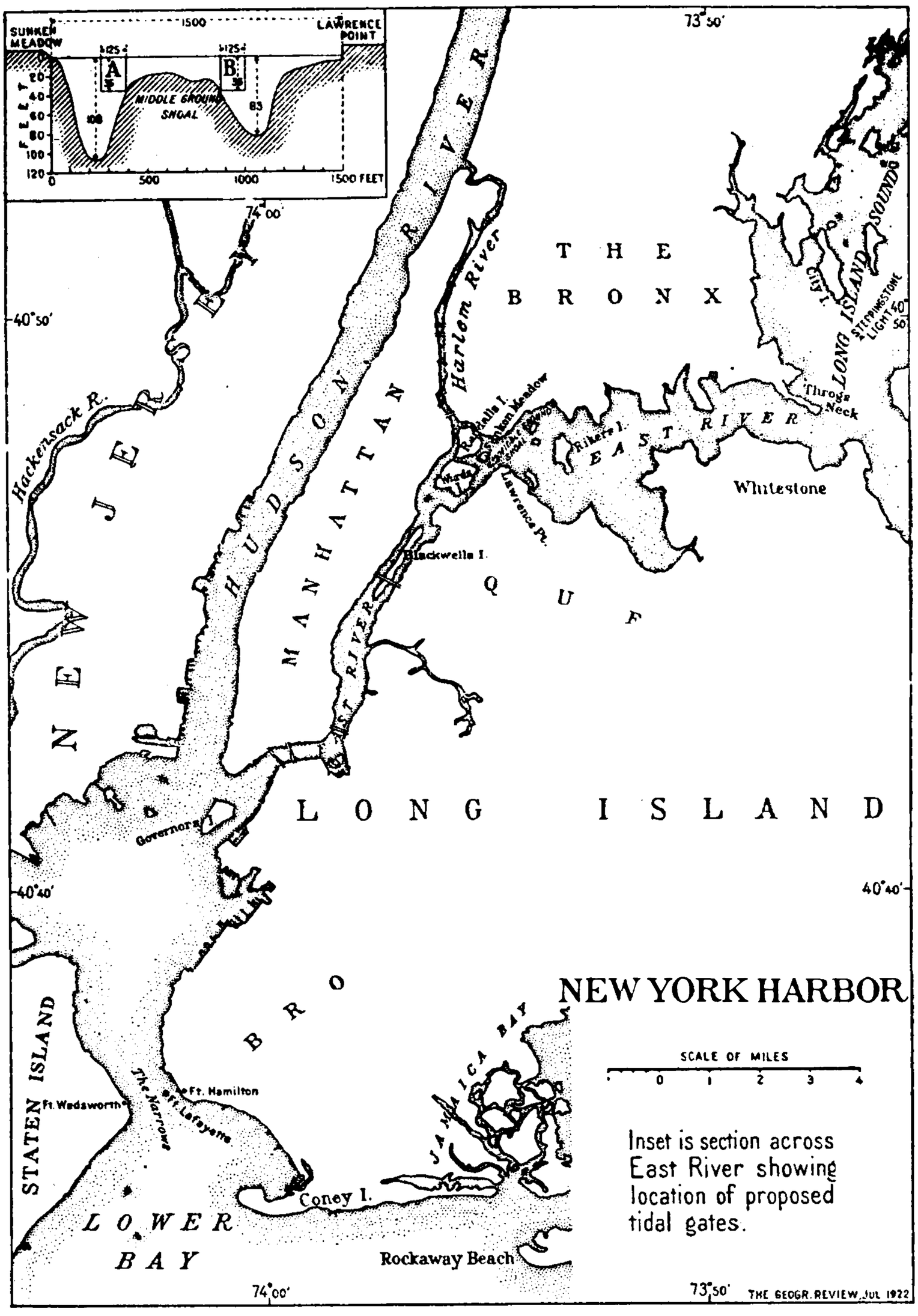


FIG. 1—Outline map of New York harbor and neighboring waters to illustrate the proposal to erect tidal gates across East River as shown in the inset section. The vertical scale of the section is five times the horizontal scale.

coming down through the Hudson is insignificant in comparison with the size of the estuary and is quite inadequate for the dilution of the city's sewage to an appreciable degree. Yet if this slight degree of cleansing did not occur, the waters of the harbor would long ago have become so foul as to be intolerable.

## INCREASING THE CLEANSING ACTION BY TIDAL GATES

The object of the present paper is to point out the fact that the natural cleansing action of the tides might be multiplied manyfold by the erection

of tidal gates in East River at some point near Wards Island. Such gates are supposed to be operated by power, automatically set into action by the turn of the tidal current, in such manner that on the eastward flow of the tide through Hell Gate they are closed, while during the westward flow they stand open. The gates would involve a problem that is not serious either from the engineering or the financial point of view, in comparison with the magnitude of the interests concerned.

Supposing such gates to be in position and operation, their closure during the flood tide would force all of that area of waterway between Wards Island and Throgs Neck, or perhaps even as far as City Island, to fill with fresh sea water from Long Island Sound instead of filling with polluted harbor water through Hell Gate, as is now the case. When the tide turned for ebb, the opening of the gates would permit the bulk of this surplus clean sea water to escape to sea through New York Harbor, instead of returning eastwardly into Long Island Sound, as it does now.

Twice every day this process would put, on the average, about ten billion gallons of pure sea water into and through New York harbor, washing out to sea through the Narrows its accumulation of impurities. The actual amount would vary from day to day, according to moon and weather; but the average amount would be about that stated—ample for rinsing out the harbor to a state of virtual cleanliness.

Since immediate objection will be made that such pollution is not wanted in the waters below the Narrows, it is to be replied that *it all goes there now, anyhow*. There is at present no appreciable efflux of sewage or other pollution into Long Island Sound. It all goes out through the Narrows, polluting the adjacent beaches before it finally dissolves in the sea. The trouble at present is that the local pollution becomes very much concentrated before it is washed out to sea. That is to say, the beaches below the Narrows, as well as the wharves in the city and both banks of the Hudson to and above Yonkers, are now washed by a relatively stationary quantity of highly polluted water.

Under the suggested plan, on the other hand, this same amount of pollution—no more and no less—would pass through the Narrows; but in the proposed situation it would be diluted, say tenfold more than it is at present. For this reason the bulk of it would flow past the adjacent shores into deep water without finding opportunity for the deposit of sediment upon the beaches; whereas now the polluted water drifts sluggishly back and forth until the wind has had time to deposit most of its burden upon the shore.

## Relation to Navigation

Since a second obvious objection to the procedure suggested lies in its interference with navigation, the inset figure is added, showing in profile the cross-sectional area of East River at a possible point for the tidal gates, namely, opposite Sunken Meadow, across Middle Ground Shoal. At this

point the channel is split in two by the Shoal, leaving a waterway 83 feet deep at mean low water to the east of the Shoal and one 108 feet deep to the west of the Shoal. This is the deepest spot in the Harbor north of the Narrows.

The inset shows how this depth conduces to the operation of the supposed tidal gates, even if gateways for navigation have to be left open during the daylight flood tide. Such ship gateways are shown at *A* for the western channel and at *B* for the eastern channel, each gateway being 125 feet wide by 36 feet deep. The profile shows that even if waterways of this size had to be left open, there would still remain a closure of the greater portion of the area available for tidal flow. This is all that is necessary. Furthermore, when the flood tide occurred during the later hours of the night this leakage due to navigation could be avoided by closing the entire area of waterway.

So great is the demand of the Flushing Bay district for sea water during the flood tide, that the latter sets in from the southward not only past Blackwells Island, but also through the circuitous path around Manhattan Island—up the Hudson River, through the Ship Canal, and then southwardly through the Harlem River. Even with this additional water supply the rate of tidal flow past Wards Island is from 2 to 3½ knots. This strong current shows how powerful would be the cleansing action, provided this flow were shut off during one tide, so as to set back in the form of clean sea water during the ebb. Then the effluent clean sea water would flow not only down East River, but also up the Harlem and into the Hudson at Spuyten Duyvil, purifying that beautiful estuary well above Yonkers.

In order to shut off this flow through the Harlem River also, on the flood tide, smaller tidal gates would have to be installed between the Sunken Meadows and Randalls Island, and also between Randalls Island and the mainland. These two channels, however, are not only small and shallow but are of no importance to navigation and hence could always be closed on the flood tide.

No estimate has been made of the cost of such tidal works, but it is obvious that it would be slight in comparison with the object sought.

# THE INFLUENCE OF GEOGRAPHIC FACTORS ON OCEAN SHIPPING*

By E. S. GREGG
U. S. Department of Commerce

In 1914 there were only four American vessels regularly crossing the Atlantic, and altogether only 735,000 tons of steamers registered for foreign trade; today there are 10.5 million tons so documented. In fact we have so many ships we do not know what to do with them. The American merchant marine, grown large and awkward in these few years, presents a problem that needs the aid not only of economists and business men but also of geographers. It is admitted that many economic handicaps will have to be overcome or neutralized by legislative or other action and that political considerations will complicate and delay a decisive settlement of our shipping problem. But geographers can render valuable service in calling attention to one important factor which has been too frequently neglected—the influence of the distribution of natural resources on industrial and maritime development. On the basis of the work of commercial geographers with reference to this factor, and with new information lately made available, it is now possible to determine, with an approach to scientific accuracy, the services essential to our trade and to formulate from the viewpoint of national economy a statement of the influence of geographic factors on the ocean shipping of a country.

## ONE-SIDED CHARACTER OF AMERICAN SHIPPING

Heretofore trade statistics have been collected mainly from the commercial viewpoint, in terms of value, and have been poorly adapted to the needs of shipping. Owing to the pioneer work of a member of the Association of American Geographers we are now getting excellent trade returns from the shipping viewpoint in terms of long tons. Under the authority of Section 21 of the Shipping Act of 1916 the master of each vessel, upon entering and clearing a port, is required by the Shipping Board to make a statement showing the total tons of cargo by principal articles on board his ship, the port of origin or destination, and other details. These reports are made by ships of 500 gross tons and over entering from, or clearing for, a foreign port. While the results compiled are not yet absolutely inclusive, the percentage of error is small; and the figures can be taken as characteristic of our commerce.

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* Read at the Washington Meeting of the Association of American Geographers, December, 1921.

The most striking point brought out by these statistics is the one-sided nature of our trade—a fact not surprising in view of the character and extent of our natural resources yet consistently overlooked by those who are volubly insisting on the desirability of a large American merchant marine. An equally important deduction follows: Shipping cannot well exist on one-way traffic. Without a bulky import trade, the United States is at a disadvantage in the ownership and operation of a large merchant fleet and certainly would find difficulty in operating one which some insist should be large enough to carry 50 per cent of the total volume of our trade.

In the year ended June 30, 1921, imports into the United States amounted to 36 million long tons, as compared with exports of 58 million; or, if bulk oil, which moves in specialized tankers, is excluded, the comparison is 18 million tons to 52 million.[1] In shipping terms this disproportion means roughly that two-thirds of the cargo ships which go out loaded must return empty. Expressed in terms of ocean freight rates, this is the equivalent of saying that outbound rates must be high enough to pay for the return of the ships in ballast. Complaints are constantly made because rates from this country are much higher than those to this country. When three ships are bidding for cargo enough for only one, and when vessel owners are faced with the necessity of buying ballast if no cargo for this country can be obtained, it is entirely logical to expect low rates on inbound traffic. Low inward rates are an aid to foreigners in landing their goods at our docks and make more difficult the placing of our goods abroad in competition with other countries.

## Analysis of the Trade of Certain American Ports

As might be expected, this overbalanced relationship between exports and imports is accentuated in certain regions and reversed in others. An analysis of the trade of some of our important ports will serve to illustrate this condition. Boston's trade is in contrast with that of the other major ports, since its imports are three times the volume of its exports: 2,349,363 tons as against 712,000 tons. New England imports heavy materials such as oil, sugar, wool, hides, and the like; it exports light miscellaneous manufactured products. Boston's imports come from raw-material-producing countries; in 1921 from Mexico, 1,012,547 tons; from India, 269,490 tons; from Cuba, 237,706 tons; from China, 113,413 tons; or 70 per cent of its total imports. To these countries Boston exported only 39,879 tons. On the other hand, Boston's exports go largely to industrial countries: to the United Kingdom, 398,800 tons; to Holland and Belgium, 70,130 tons; and to Germany, 60,684 tons; or 73 per cent of its total exports. Imports from these countries into Boston in 1921 amounted to 219,221 tons and made a more nearly balanced trade of manufactured goods moving both ways.

[1] *Commerce Repts.*, Sept. 26, 1921, p. 243; *ibid.*, Nov. 21, 1921, pp. 713–714. Figures for the ports are taken from these articles and from the more detailed material in the Bureau of Foreign and Domestic Commerce on which they are based.

Middle West wheat and steel products, necessary for what might be called ballast for the light products of the region, are not now moving through Boston. It is not unusual for a ship to discharge at Boston and then proceed to New York to take on a load of products originating around Boston. New England, with its scanty natural resources and its advanced industrial development, is having difficulty in supporting direct shipping.

The Hampton Roads ports are an example of the contrary situation. Norfolk and Newport News together exported 12,026,257 tons in the fiscal year 1921 and imported less than 300,000 tons. Exports from these ports were greatest to South America—2,676,816 tons; and strangely enough, next in order was the United Kingdom, which took 1,337,622 tons; France followed with 1,301,016 tons; then Germany, Holland, and Belgium with 906,350 tons together, Italy with 895,670 tons, and Cuba with 471,177—a total of 7,588,651 tons out of 12,026,257. These regions sent only 188,341 tons into Hampton Roads. The ships of all countries are called upon for this export movement, which is mainly coal, and the choice is uniformly on the basis of the lowest rate. The fact that this trade is unbalanced does not keep shipping from the Roads, since many countries must have our fuel; but, because of other economic handicaps, the large outbound movement of coal is not of the advantage to our shipping that the British exportation of coal is to British shipping, as will be shown later.

Few cases illustrate better the influence of the geographic distribution of natural resources on shipping. The distance from Cardiff to Buenos Aires is greater than that from Hampton Roads; yet a British vessel can carry coal to the Argentine as cheaply and certainly more profitably than an American vessel can carry it from Norfolk. The British vessel brings back a load of wheat, which pays part of the expense; the American ship generally comes back empty. Nature and the trend of economic development have given the United Kingdom a fairly well-balanced trade as the result of its coal deposits. From the shipping standpoint the United States labors under the handicap of abundant natural resources, however paradoxical this may seem.

The disparity between outbound and inbound traffic is not so great in the case of San Francisco. Exports in 1921 totaled 1,291,505 tons, against imports of 882,826 tons. Steel, oil, grain, and lumber go out, while jute, coconut meat and copra, nitrate of soda, rice, and vegetable oils—all fairly heavy—come in. The trade of San Francisco with Australia and New Zealand almost balanced, imports into San Francisco amounting to 82,149 tons and exports amounting to 80,788 tons; likewise its trade with India almost balanced—45,328 tons inbound, 42,974 outbound. On the other hand, 100,022 tons were brought in from the east coast of Mexico, to which nothing was sent; while imports from the west coast of Mexico totaled 6,463 tons as against exports to that section of 19,879 tons.

The outbound trade of New York amounted to 11,341,351 tons, as compared with 9,205,809 tons inbound. Imports from Mexico were 3,525,374

tons, or over one-third of the total; and most of this trade consisted of crude oil carried in specialized vessels. This means that general cargo vessels carrying freight from New York found, on an average, scarcely more than half a shipload of cargo for the return voyage. A detailed discussion of the trade of New York would serve to show the extent of this disparity on the various routes; but such an analysis will not be attempted here. Data on this point will subsequently be published.

## The Kind of Shipping We Need

In considering the steamship services necessary for our trade, it is of primary importance to recognize that the imports of oil and the exports of bulky raw materials must be considered separately. As already pointed out, crude oil moves in specialized vessels which are an integral part of a very profitable business. The exports of heavy raw materials go largely in tramp ships, a type of service this country can not logically be expected to develop. These raw materials normally move to the seaboard before being sold ultimately, so that it is difficult for the seller to divert his shipment to an American vessel. In other words, our real problem is that of determining and establishing liner services to carry a reasonable share of our trade in manufactured and semi-manufactured goods with enough heavy raw materials to make each cargo stow to advantage.

If crude oil is excluded from imports, and coal, bulk oil, grain, cotton, and lumber from exports, the result is an inward and outward volume of cargo fairly well balanced. In the year ended June 30, 1921, out of a total exportation of 58 million tons, exports of coal, bulk oil, grain, cotton, and lumber accounted for approximately 35 million tons,[2] leaving about 23 million tons of miscellaneous commodities; as against imports, exclusive of oil, of about 18 million tons.

The uncritical statement is made that the United States needs a merchant marine of 10 million gross tons to carry 50 per cent of its products. I suspect that a careful analysis would lead to the conclusion that all the cargo and passenger shipping we can support from the profits of operation plus any subsidies which are likely to be granted, is the quantity of tonnage necessary to transport 50 per cent of our imports, excluding oil, and 50 per cent of our exports, excluding coal, grain, cotton, and the like. One hesitates to make this statement because it is preliminary in character and because it is likely to be misunderstood by partisans of certain grandiose schemes. But the discussion must be brought down from the air and grounded in the facts of the case. It is hoped that shortly a defensible estimate of the quantity and character of tonnage necessary to move 50 per cent of our manufactured and semi-manufactured goods can be put forward for critical analysis and revision.

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[2] *Monthly Summary of Foreign Commerce of the United States*, June, 1921. Part I.

## Disadvantage of a Country Rich in Natural Resources

On the basis of what has been outlined it may be said that a country which has been endowed liberally by nature with raw materials necessary to an advanced industrial development cannot maintain, except at an unusual expense, a merchant marine large enough to carry 50 per cent of its total trade. The exploitation of its natural resources is more profitable than shipping ventures. It loses interest in its materials as soon as they are sold and rarely cares in what vessels they are shipped. The exportation of primary commodities will unbalance its trade, and the profitableness of trafficking in these articles, so eagerly sought after by other less fortunate countries, makes unnecessary, and therefore unlikely, the development of that peculiar genius of management and economy needful for the successful operation of ships on multilateral voyages. In other words, there is not sufficient economic pressure to produce tramp ship operators, and tramps are the type of ships needed for bulky materials. The United States is a case in point, though other raw-material countries illustrate the point equally well. Spain's imports in 1920 were 3.7 million tons, as compared with exports of 8.7 million.[3] A large part of the outward movement was ore, and Spain can be considered as a raw-material country with an insignificant merchant marine in proportion to its trade.

Countries poor in natural resources, but with large and vigorous populations, are forced into lines of activity which do not pay so well perhaps as exploiting the gifts of nature. These alternative activities are usually international trade and services, and of these the shipping industry is inevitably one of the most important. Looked at in perspective, international trade has been the exploitation of the raw materials of countries with little industrial development by those countries which have progressed further along that line. On the other hand, the tendency now seems to be for each of the countries more backward industrially to force, by protection or other means, the growth of manufactures. One refrains from trying to conceive what will happen when all countries are developed to the *n*th degree industrially, or to calculate where and what the profit in trade will be.

## Ocean-Trade Advantage of the United Kingdom

It is necessary for countries poor in natural resources to bring in bulky raw materials. These pay something toward the expenses of a ship's operation and consequently enable lower outward rates to be made on finished products. The United Kingdom, quite apart from its geographic location, is an example. The large outward movement of coal makes it possible for British ships to bring in the essential foodstuffs and raw materials cheaply, and the importation of large quantities of bulky products enables favorable rates to be made on the export of British manufactured goods. Exports

[3] *Commerce Repts.*, Dec. 5, 1921, p. 849.

from the United Kingdom in 1913 amounted to 106.4 million tons, of which 73 million tons were coal. Imports totaled 55.4 million tons. If the continental coal trade is excluded, and it should be because it is little more than a coastwise business, the oversea movement was 57.3 million tons outward and 55.4 million inward.[4]

The British Board of Trade, in its report "Shipping and Shipbuilding Industries After the War," stated that:

> A considerable part of the earnings of the steamship lines was derived from . . . inward freights . . . and British manufactures were, therefore, carried abroad at rates which could not have been accorded but for the existence of highly organised services with a considerable volume of trade in other directions. . . . "The principal freight being earned homewards enabled the lines to fix favourable rates of freight on British exports; and shippers not only had the benefit of fast modern tonnage and could rely on definite sailings at not only frequent but regular intervals, but contracts at low rates were given to associated British trade to enable it to secure foreign orders." The practice of according specially low rates of freight to British exports was, however, the exception rather than the rule in the Central American and West Indian trades where inward cargoes were less abundant.[5]

## The Cases of Germany and Japan

Germany is another case in point. Before the war heavy exports of coke helped to give full cargoes for ships clearing for foreign ports, and the importation of bulky raw materials helped to defray the cost of maintaining ships, enabling them to carry out German finished products at favorable rates.

While the rapid growth of the Japanese merchant marine has been due to many factors, one of which was heavy subsidies, geographic and economic conditions favor an expansion of Japanese shipping. The volume of Japanese imports in 1913 almost balanced with the volume of exports—5.3 million tons of imports as compared with 4.6 millions tons of exports, on the basis of the more important items. The trade is perhaps nearer balanced than these figures indicate, since the import figure includes 89 per cent of the total value of imports while the export figure includes only 63 per cent of the total value of exports. It seems necessary for a country which must depend upon the importation of essential commodities to maintain a large merchant fleet. But a country which possesses abundant natural resources has not the same need; other countries will come to its doors.

It is clearly recognized that the character of the trade of a country, while a neglected factor, is not the only one. With economic and political considerations bulking large, it is not necessarily the determining factor with reference to the maintenance of a great merchant fleet. If this aspect of the problem has been overemphasized here, it is probable, to quote the words which Malthus uses with reference to his theory of population, "that having found the bow bent too much one way I was induced to bend it too much the other in order to make it straight."

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[4] *Supreme Econ. Council Monthly Bull. of Statistics*, Vol. 2, 1920–21, No. 3, p. 29; and *Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions*, Cd. 7968, Vol. 1, 1914, p. 319.

[5] Reports of the Departmental Committee Appointed by the Board of Trade to Consider the Position of the Shipping and Shipbuilding Industries After the War, H. M. Stationery Office, London, 1918, pp. 149–150.

Additional facts are needed, and the machinery is being set up to get them. It is only fair also to admit that some terms susceptible of several interpretations have been used and that critical consideration is needed to clarify and establish their usage. When more complete data are obtainable and analyzed, a better formulation of a theory of the influence of geographic factors on the national maintenance of a merchant fleet can be made, and considerable light will be thrown on the shipping problem now before this country.

# RECENT GEOGRAPHICAL WORK IN EUROPE

By W. L. G. JOERG


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|---|---|---|---|
| Great Britain | 432 | Norway | 469 |
| France | 438 | Sweden | 470 |
| Germany | 441 | Finland | 473 |
| Italy | 449 | The Baltic States | 475 |
| Spain | 454 | Poland | 475 |
| Portugal | 457 | Czechoslovakia | 477 |
| Belgium | 458 | Hungary | 478 |
| The Netherlands | 460 | Rumania | 480 |
| Switzerland | 462 | Yugoslavia | 482 |
| Austria | 464 | Bulgaria | 483 |
| Denmark | 468 | Greece | 483 |


The present article is based on observations made in 1921 while on six months' leave of absence granted by the American Geographical Society and during a sojourn in Europe ten to thirteen years before, as well as on printed sources of information. The countries visited on both occasions were England, France, Germany, Belgium, the Netherlands, Switzerland, and Italy. In addition there were visited, in 1921, Scotland and Spain, and, on the earlier occasion, the following countries (as now constituted): Denmark, Czechoslovakia, Austria, Hungary, Yugoslavia, and Rumania. The discussion, which attempts to deal with all of Europe except Russia, lays no claim to being balanced or uniform in emphasis; indeed, it only reflects what has happened to come to the writer's attention. For the inevitable omissions, and for the possible inaccuracy in statement of information learned in conversation only, the writer begs the indulgence of his fellow-workers abroad. For their many courtesies and their constant helpfulness he is deeply grateful.

On the accompanying map are shown universities giving instruction in geography and geographical societies, as the existence or non-existence of such institutions possibly best reflects the general state of development of geography in a given country. This information is compiled from the latest edition of handbooks and other publications,[1] checked from personal

[1] Especially the general handbooks: (1) Minerva: Jahrbuch der gelehrten Welt, Vol. 25 for 1921, Berlin and Leipzig, 1921; (2) Index Generalis: Annuaire général des universités, etc., 2nd issue, Paris, 1921. For the respective countries the following are valuable: (1) Athena: A Yearbook of the Learned World: The English Speaking Races, New York, 1920; (2) Les ressources du travail intellectuel en France, Paris, 1921; (3) Annuario degli istituti scientifici italiani, 2nd issue, Bologna and Rome, 1920.

Of geographical societies the only systematic list still is the one in *Geogr. Jahrbuch*, Vol. 32 for 1909, pp. 411–418. More recent information with regard to some may be found in Index Generalis for 1921, pp. 1342–1349 (incomplete list), and for individual countries in the regional handbooks referred to above; for France, in addition, in *La Géogr.*, Vol. 36, 1921, p. 141.

A general survey of the status of geography in the different countries is afforded (1) by the conference held at the University of Virginia during the American Geographical Society's Transcontinental Excursion of 1912 (Proceedings of a Called Meeting of the Scientific Section, *Univ. of Virginia Publs.: Proc. Philos. Soc.*, 1911–12, pp. 99–134, and The Conference on Geographical Education Held During the Transcontinental Excursion of 1912, *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, pp. 121–126) and (2) by the reports of progress during the last 25 years made to the Tenth International Geographical Congress at Rome, 1913 (*Atti del X Congr. Internaz. di Geogr., Roma 1913*, Rome, 1915, pp. 116–392). Cf. also pp. 135–139 of R. H. Whitbeck: Geography in American and European Universities, *Journ. of Geogr.*, Vol. 18, 1919, pp. 129–141.

observation. The point of view is, on the whole, conservative. Only universities are shown at which geography in the modern sense is taught; in some cases one or two branches only may be represented, such as phytogeography or oceanography, but at the great majority of universities shown the subject is presented completely. Of geographical societies it is intended to show only those that are doing active work (mainly, publishing), with due allowance for war interruption. Where a society maintains a number of branches, as is the case with several societies, particularly in France, only the main society is shown. For the countries other than Russia not shown on the map (Rumania, Bulgaria, Greece) the universities and geographical societies are indicated in the title. Other institutions of importance to geography, such as survey organizations and institutions devoted to related sciences, are not shown on the map; some of them are referred to in the text.

## Great Britain

In keeping with her traditional liberalism, Britain, more than any other country in Europe, it would seem, is making geography serve as a medium for the more sympathetic understanding of other peoples. In England, too, as on the Continent, the subject is of course being advanced for its utilitarian value, for the knowledge that is power, but nowhere else is its ideal function being emphasized so much as in England. The late Professor Herbertson may be counted as one of the leading exponents of this view. We need only recall his last papers,"Regional Environment, Heredity, and Consciousness" [2] and "The Higher Units."[3] It is generally conceded that he was on the threshold of great things when his career was cut short. His untimely death has been a great loss. But his work goes on. Professor H. J. Fleure of the University College of Wales at Aberystwyth approaches the problem from the anthropological side, from the study of early civilizations. By studying the accumulated tradition of a people, he aims to gain an insight into their spirit.[4] Applied to the local region, this method is the essence of the "regional survey" movement,[5] which has a widespread following. By imparting an understanding of the *genius loci*, it aims to train for better citizenship. This movement is in large measure the outgrowth of the work of Professor Patrick Geddes and puts into effect the ideas of his Outlook Tower in Edinburgh, a museum of civic geography with a world outlook.[6] Professor Geddes was appointed after the war to the chair of sociology at the University of Bombay, following the fruitful application of the town-planning principles of his "Cities in Evolution" (London, 1915) to Indian

[2] *Geogr. Teacher*, Vol. 8, 1915–16, pp. 147–153.

[3] *Scientia* (published in Bologna), 1913, No. 5.

[4] Cf. "Human Geography in Western Europe," London, 1918; France: A Regional Interpretation, *Scottish Geogr. Mag.*, Vol. 32, 1916, pp. 519–534 (on both publications see *Geogr. Rev.*, Vol. 6, 1918, pp. 515–516); Countries as Personalities (address at meeting of British Assoc. Adv. Sci., Edinburgh, Sept. 12, 1921).

[5] Cf. A Conference on Regional Surveys, *Geogr. Teacher*, Vol. 8, 1915–16, pp. 89–102 and 164–172.

[6] In it are embodied some of the ideas expressed in Patrick Geddes: Note on Draft Plan for Institute of Geography, *Scottish Geogr. Mag.*, Vol. 18, 1902, pp. 142–144, with plan; and J. G. Bartholomew: A Plea for a National Institute of Geography, *ibid.*, pp. 144–148.

cities. Quite recently he has been engaged on similar work for Jerusalem.[7] Dr. J. F. Unstead, head of the geography department at Birkbeck College, University of London, is another advocate of world knowledge as a basis for

FIG. 1—Map showing the universities giving instruction in geography and the geographical societies of Western Europe. Scale, 1 : 22,500,000. To cover the same ground as the text, the following should be added: in Rumania, universities at Bukharest, Jassy, Cluj (Kolozsvár), Czernowitz, and geographical society at Bukharest; in Bulgaria, university at Sofia.

a sympathetic understanding of other peoples. As chairman of the Geographical Committee of the League of Nations Union he has been devoting himself to this problem. His views are expressed in two recent publications, a book entitled "Europe of Today" (London, 1921), the first of a series of

[7] Patrick Geddes: The City of Jerusalem, *Garden Cities and Town-Planning* (London), Vol. 11, 1921, pp. 251–254.

"Citizens of the World Geographies," and a paper on "The Study and Teaching of International Relations."[8] The study of one of the most important questions of international relations has been taken up by Professor P. M. Roxby of the University of Liverpool. In 1912–13, as Kahn Traveling Fellow, he visited China and Japan, and he is at present in China as adviser to the Chinese Government in the reorganization of the schools and colleges hitherto maintained by missionary societies. It is expected that Professor Roxby will visit the United States on his return to England this summer. He has dealt with his field of study mainly in "The Far Eastern Question in Its Geographical Setting"[9] and "Some Aspects of the Geography of China."[10]

## Senior Workers in Geography

Of those who were closely associated with the creation of modern geography in Great Britain several are still active. Sir John Scott Keltie, late Secretary of the Royal Geographical Society, whose fundamental investigation of the status of geography on the Continent, undertaken in 1884 and 1885 on the Society's behalf, provided the groundwork for the action taken in introducing the subject in British universities, is still vigorous in spite of his four score years and more, as evidenced by his recent report on "The Position of Geography in British Universities"[11] and his earlier "Thirty Years' Progress in Geographical Education."[12] Sir H. J. Mackinder, who preceded Herbertson as Reader at Oxford, has remained, as member of Parliament, loyal to our subject. His suggestive book "Democratic Ideals and Reality" (London, 1919),[13] indeed, is a fruitful application of the geographical viewpoint to political questions. His continued activity on behalf of the advancement of geography is betokened by his "Presidential Address to the Geographical Association, 1916"[14] and "Geography as a Pivotal Subject in Education."[15] Dr. H. R. Mill, the veteran Director of the British Rainfall Organization, whose failing eyesight forced him to relinquish that position in 1919, has fortunately so recovered that he is again able to be an active participant in geographical meetings. His recent Herbertson Memorial Lecture, "The Value of Regional Geography,"[16] will be read with interest, not the least because of its reminiscent strain.

## Geography at the Universities

As regards the present representation of geography at the universities: sixteen out of a total of eighteen in Great Britain include the subject in their

[8] *Geogr. Teacher*, Vol. 11, 1921–22, pp. 136–140.

[9] *Geogr. Teacher*, Vol. 10, 1919–20, pp. 82-90, 142–150, and 253–269, With map on p. 270 (abstracted in the *Geogr. Rev.*, Vol. 12, 1922, pp. 138–139).

[10] *Ibid.*, Vol. 8, 1915–16, pp. 1–5.

[11] *Amer. Geogr. Soc. Research Series No. 4*, New York, 1921.

[12] *Geogr. Teacher*, Vol. 7, 1913–14, pp. 215–227.

[13] Cf. F. J. Teggart: Geography as an Aid to Statecraft: An Appreciation of Mackinder's "Democratic Ideals and Reality," *Geogr. Rev.*, Vol. 8, 1919, pp. 227–242.

[14] *Geogr. Teacher*, Vol. 8, 1915–16, pp. 271–277.

[15] *Geogr. Journ.*, Vol. 57, 1921, pp. 376–384.

[16] *Geogr. Teacher*, Vol. 11, 1921–22, pp. 63–75 (incorrectly numbered pp. 7–19). Noticed in *Geogr. Rev.*, Vol. 11, 1921, p. 629.

curriculum. At ten of these it is a subject for the Honours degree, i.e. a degree requiring advanced work and specialization.[17] At Oxford, which was the first and remains the best equipped School of Geography, Mr. H. O. Beckit is Reader. In addition, geography is the gainer by the work of Professor J. L. Myres in the relations of history and geography and of Dr. D. G. Hogarth on the Near East. Some aspects of the war work with which Dr. Hogarth was in touch as head of the Arab Bureau in Cairo he has fascinatingly described in two articles.[18] His Presidential Address on "Applied Geography"[19] before Section E (Geography) at the Edinburgh meeting of the British Association for the Advancement of Science in September, 1921, will also be read with interest. At Cambridge the present Honours standing of geography dates from the establishment of the Geographical Tripos, in 1919.[20] Mr. Philip Lake is Reader in regional and physical geography, Mr. H. Yule Oldham lecturer in historical geography, and Mr. Frank Debenham lecturer in cartography. Mr. Debenham, who was a member of Scott's Antarctic expedition, has recently been advocating the establishment of a polar research institute.[21] Dr. A. C. Haddon's work as Reader in ethnology has much geographical bearing.

Among other universities where geography is being actively forwarded should be mentioned: the University of Liverpool, where Professor Roxby has built up a strong department, recently acquiring an entire private house, which has been made over and furnished with a wide range of equipment; the University of London, with which are connected Mr. James Fairgrieve, author of "Geography and World Power" (London, 1915), who gave a course on "The Geographical Factor in History" at the University of Chicago during the 1921 summer term, and (at University College) Professor L. W. Lyde, well known for his "The Continent of Europe" (London, 1913), as professor of economic geography; the University College of Wales at Aberystwyth, where Professor Fleure, through his courses and his editorship of the *Geographical Teacher*, is exercising marked influence on the development of geographic thought in Great Britain; the University of Leeds, where the Reader is C. B. Fawcett, whose discussion of a proposed new administrative subdivision of Great Britain on geographical lines has recently appeared in book form;[22] the University of Sheffield, where Dr.

[17] On geography in British universities cf. the valuable tabular synopsis in *Scottish Geogr. Mag.*, Vol. 37, 1921, pp. 272–273, and the account by Sir J. S. Keltie mentioned in footnote 11 as well as the synopsis in *Geogr. Teacher*, Vol. 7, 1913–14, pp. 194–209, and the previous synopses there mentioned. On British universities in general cf.: The Universities of the United Kingdom of Great Britain and Ireland: A Handbook Compiled by the Universities Bureau of the British Empire, *Board of Education Educational Pamphlet No. 33*, London, 1918 (prepared on the occasion of the visit of delegates from British universities to American universities at the invitation of the Council of National Defense).

[18] War and Discovery in Arabia, *Geogr. Journ.*, Vol. 55, 1920, pp. 422–439; Some Recent Arabian Explorations, *Geogr. Rev.*, Vol. 11, 1921, pp. 321–337.

[19] E.g. in *Scientific Monthly*, Vol. 13, 1921, pp. 322–327.

[20] Cf. Philip Lake: The Geographical School at Cambridge, *Geogr. Teacher*, Vol. 10, 1919, pp. 80–81; and W. M. Davis: Geography at Cambridge University, England, *Journ. of Geogr.*, Vol. 19, 1920, pp. 207–210.

[21] Frank Debenham: The Future of Polar Exploration, *Geogr. Journ.*, Vol. 57, 1921, pp. 182–204.

[22] Provinces of England: A Study of Some Geographical Aspects of Devolution, London, 1919 (expanded from Natural Divisions of England, *Geogr. Journ.*, Vol. 49, 1917, pp. 124–141, abstracted in *Geogr. Rev.*, Vol. 7, 1919, pp. 114–115, with map).

R. N. Rudmose Brown, who has specialized in Spitsbergen,[23] is head of the department; the University College, Southampton, at which Professor W. H. Barker has been developing an Institute of Geographical Study, favored by the proximity of the Ordnance Survey and the world "clearing-house" function of the port; the University of Edinburgh, at which geography has long been represented by Mr. G. G. Chisholm, who is at present producing a new edition of his well-known "Handbook of Commercial Geography"; and the University of Aberdeen, at which Mr. John Macfarlane is lecturer in geography. The old-established geography department at the Victoria University of Manchester has, since Mr. A. G. Ogilvie joined the staff of the American Geographical Society, unfortunately been without a head; but this condition will soon be changed, as, it is understood, Professor Barker has accepted a call to go there.

## Work of Institutions

Institutions other than universities are, of course, contributing to the advancement of geography in Great Britain. Of the Royal Geographical Society's work there can only be mentioned the Mt. Everest expedition, the recently inaugurated Technical Series,[24] and the war-time production, in co-operation with the Geographical Section of the General Staff, of a map on the scale of 1 : 1,000,000 covering practically all of Europe and the Near East, which took the place of the—for the greater part of the area—non-existent International Map of the World and which did substantial service during the war. The war work of the Ordnance Survey is described in "The Ordnance Survey and the War, 1914–1919," published by the Survey in Southampton in 1919. The position of Archeology Officer, recently created on the staff of the Survey, is filled by Mr. O. G. S. Crawford, author of "Man and His Past" (London, 1921) and the article "Prehistoric Geography" in the *Geographical Review* for April. His duties involve the search for and indentification of ancient remains, including prehistoric barrows and Roman sites, and their plotting on the six-inches-to-the-mile map. The Ordnance Survey, as the Central Bureau, has also recently published a report, with index maps, on the status of the International Map of the World.[25] Of the various war and peace conference publications of government bureaus the most important are the two series of handbooks on the problem areas of the world compiled by the Historical Section of the Foreign Office[26] and the Geographical Section of the Naval Intelligence

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[23] The substance of several articles (e. g. Spitsbergen: Terra Nullius, *Geogr. Rev.*, Vol. 7, 1919, pp. 311–321) is contained in Dr. Rudmose Brown's book "Spitsbergen," Philadelphia, 1920.

[24] No. 1: Some Investigations in the Theory of Map Projections, by A. E. Young; No. 2: Alphabets of Foreign Languages Transcribed Into English According to the R. G. S. II System, by Major-General Lord Edward Gleichen and J. H. Reynolds.

[25] Carte du Monde au Millionième: Rapport pour 1921, Bureau Central, Ordnance Survey Office, Southampton.

[26] For a list see *Geogr. Teacher*, Vol 10, 1919-20, p. 311. See also *Geogr. Journ.*, Vol. 56, 1920, pp. 216–219 and 314–316.

Division.[27] New geographical work on the far-flung battle lines of the world war,[28] and airplane mapping,[29] are reflected in many articles.

Mention should be made of the admirable Edinburgh (Aug.-Sept.-Oct. 1919) and Glasgow (Jan. 1921) numbers of the *Scottish Geographical Magazine*,[30] the former with a suggestive map of the historical growth of the city by the late Dr. J. G. Bartholomew, which formed a valuable corollary to the discussion of "The Geography of Edinburgh and District: Past, Present, and Future Outlook" at a session of Section E of the Edinburgh meeting of the British Association and to the handbook issued on that occasion.[31] At that meeting Dr. Marion I. Newbigin, editor of the magazine, read an illuminating paper on "The Mediterranean City-State in Dalmatia." From her earlier general discussion of Balkan geography, of which this paper represented a special problem, she has recently proceeded to a geographical consideration of the peace settlements.[32]

One of the last undertakings to which the late Dr. Bartholomew was able to devote his attention is the "Times Survey Atlas of the World" (London, 1921), recently completed. The use throughout the atlas of the layer method to represent relief, of which he was the leading exponent,[33] is a distinctive contribution, which for the first time in a work of this type makes this fundamentally important geographical element easily understandable by the general public. Among other outstanding British map publications may be mentioned the recent (London, 1922) series, by Mr. George Philip, of wall maps of the continents showing commercial development, which carry out, with refinement of method, the suggestive manner of portraying the facts of economic geography which he outlined some years ago.[34] Of interest to American teachers is the recent publication, under his editorship, of a set of maps of the United States in 1:4,500,000, in the series by Unstead and Taylor in which there is a map for each of the significant phases of the geography of each continent.

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[27] For a list see *Geogr. Teacher*, Vol. 11, 1921–22, p. 39 (the issue containing this page is incorrectly allotted to Vol. 12) and p. 113 (incorrectly numbered p. 57). See also *Geogr. Journ.*, Vol. 57, 1921, pp. 51–52.

[28] H. St. J. B. Philby, *Geogr. Journ.*, Vol. 55, 1920, and Vol. 56, 1920; E. H. Keeling, *ibid.*, Vol. 55, 1920; L. C. Dunsterville, *ibid.*, Vol. 57, 1921; Percy Sykes, *ibid.*, Vol. 58, 1921; L. V. S. Blacker, *ibid.*, Vol. 58, 1921; and three systematic papers by A. G. Ogilvie: Notes on the Geography of Imbros, *Geogr. Journ.*, Vol. 48, 1916, pp. 130–145; A Contribution to the Geography of Macedonia, *ibid.*, Vol. 55, 1920, pp. 1–34; Physiography and Settlements in Southern Macedonia, *Geogr. Rev.*, Vol. 11, 1921, pp. 172–197.

[29] H. H. Thomas, *Geogr. Journ.*, Vol. 55, 1920; H. A. Lloyd, *ibid.*, Vol. 56, 1920; S. F. Newcombe, *ibid.*, Vol. 56, 1920; E. M. Dowson, *ibid.*, Vol. 58, 1921.

[30] See note in *Geogr. Rev.*, Vol. 11, 1921, pp. 298–299.

[31] Edinburgh's Place in Scientific Progress. Prepared for the Edinburgh Meeting of the British Association by the Local Editorial Committee, Edinburgh and London, 1921. (With chapters on meteorology, geology, oceanography, and geography.)

[32] Aftermath: A Geographical Study of the Peace Terms, Edinburgh, 1920 (reviewed in the *Geogr. Rev.*, Vol. 11, 1921, p. 452).

[33] An appreciation of Dr. Bartholomew's contribution to cartography appears in the obituary notice, *Scottish Geogr. Mag.*, Vol. 36, 1920, pp. 183–185.

[34] A New Series of Economic Maps for School Use, *Geogr. Journ.*, Vol. 50, 1917, pp. 438–447, with map, Eurasia: Commercial Development, 1:40,000,000.

## France

Let us now turn to France.[35] Geography is represented, and well represented, at practically all of the sixteen universities of France.[36] Nearly all the occupants of the chairs of geography are pupils, or pupils of pupils, of the late Vidal de la Blache.[37] In no country, it may be said, not even in Germany with her Richthofen, has the development of modern geography so centered about one man as in France. And France may be content. The school that she has developed is the admiration of professional geographers the world over. The national ideals of unity and beauty, translated in the scientific world into synthesis and sense of proportion, are peculiarly valuable in geographic work. From this school has come, and is coming, that excellent series of regional studies of France,[38] introduced by Vidal de la Blache's own admirable "La France: Tableau géographique."

Recognizing that an adequate regional treatment of the world is the fundamental desideratum of modern geography, the leading French geographers had, some years before the war, begun on a series of regional geographies intended to cover the world, in which each region or country was assigned to a specialist.[39] Several of the volumes were already in manuscript when the war broke out and completely stopped the undertaking. Now, fortunately, it is possible to proceed again, and we may within reasonable time look forward to regional geographies of the first order from such men as Gallois, De Martonne, Demangeon, and others.

## Bibliographies

Another fundamental undertaking of the French, the annual bibliography of the *Annales de Géographie*, suppressed by the war since the volume covering 1913–14, has again been taken up. A volume covering 1915–19 has just appeared, edited by Monsieur Elicio Colin, as Monsieur Louis Raveneau, the veteran bibliographer, felt compelled to relinquish the editorship. Its appearance is in part made possible by a subsidy from the "Association de Géographes Français," a recently founded organization of professional

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[35] For an excellent brief account of the development of geography in France, with a list of the leading works that are products of the French school, see E. de Martonne: La science géographique, pp. 375–396 of Vol. 2 of "La Science Française," 2 Vols., Paris, 1915, published on the occasion of the Panama-Pacific Exposition at San Francisco.

[36] This number does not include the University of Algiers, which forms part of the French university system and at which geography is well represented, nor the five Catholic universities, at four of which (Angers, Lille, Lyons, Paris) geography is taught. For a valuable synopsis of geographical courses given at French universities, see "Cours en langue française professés pendant l'année scolaire 1921–22," *La Géogr.* (Paris), Vol. 36, 1921, pp. 555–558 (for 1920–21, *ibid.*, Vol. 34, 1920, pp. 425–427; for 1899–1900, *Ann. de Géogr.*, Vol. 9, 1900, pp. 83–85). Cf. also L. Gallois: La géographie dans l'enseignement supérieur en France, *La Geografia* (Novara), Vol. 6, 1918, pp. 495–500.

[37] On Vidal de la Blache's influence on the development of geography in France, see L. Gallois and E. de Martonne: Paul Vidal de la Blache, *Geographen Kalender*, Vol. 8, 1910, Gotha, pp. viii–xxx; and L. Gallois: Paul Vidal de la Blache, *Ann. de Géogr.*, Vol. 27, 1918, pp. 161–173.

[38] List in De Martonne, La science géographique, cited above, and *Geogr. Teacher*, Vol. 9, 1917–18, pp. 202–203.

[39] Cf. note in *Geogr. Rev.*, Vol. 1, 1916, p. 55.

geographers akin to our own Association of American Geographers and, indeed, it is understood, partly inspired by it. During the temporary lapse of this publication the bibliography compiled by S. Reizler, librarian of the Paris Geographical Society, and appearing since 1919 (Vol. 32, No. 5) in each number of its monthly organ, *La Géographie*, has, although less systematic and critical, done invaluable service.

## Geography at the Sorbonne

Owing to the French system of centralization, geography is of course best represented at the University of Paris, i.e. at the Sorbonne. It is there in the tried hands of Professors L. Gallois, E. de Martonne, and A. Demangeon. Inasmuch as the subject has in France had the opposite development to what it has had with us, namely developing from history instead of from geology, in its modern aspect it is a subject belonging primarily, at all the universities, to the Faculté des Lettres. With the prestige of Paris, however, geography, as physical geography, is also represented on the Faculté des Sciences (by Professor L. Gentil).[40] But the modern conception of the subject prevails so completely that physical geography is as a matter of course included in the curriculum of the Faculté des Lettres at the Sorbonne; indeed it is there represented by Professor De Martonne. As a result of a recent gift a building has been erected in the university quarter near the Prince of Monaco's Institut Océanographique, at the corner of the rue St. Jacques and the rue Pierre Curie, and is nearing completion, for the exclusive use of the department of geography. It will house the staffs of both faculties. With this needed improvement in its physical equipment, we may look forward to even greater things from this center of French geographic learning.

## The Provincial Universities

Among the leading geographers at the provincial universities may be mentioned Professor Raoul Blanchard, at Grenoble, who has built up an excellent department specializing in the geography of the Alps, the work of which is published in the *Recueil des Travaux de l'Institut de Géographie Alpine* (now *Revue de Géographie Alpine*); Professor Camena d'Almeida, at Bordeaux, who knows Spain thoroughly; and, at the new University of Strasbourg, Professor H. Baulig, the department at which, curiously behind-hand under the old régime in this former outpost of the Empire,[41] has been moved from the old German university building to the former Imperial Palace. At Strasbourg the well-known geographer-geologist, Monsieur E. de Margerie, translator and amplifier of Suess's "The Face

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[40] Louis Gentil: La chaire de géographie physique de la Faculté des Sciences de Paris, *Revue Scientifique*, 1920, No. 1, 32 pp.

[41] H. Baulig: Le "Geographisches Seminar" de l'Université de Strasbourg, *Revue Internatl. de l'Enseignement*, May 15–June 15, 1920, pp. 206–211.

of the Earth," has been appointed director of the Geological Survey of Alsace-Lorraine. A second chair of geography at the university was offered to Pierre Denis, recently author of an important work on Argentina[42] which rivals his former standard "Le Brésil au XX$^{ème}$ Siècle," but he declined, joining, instead, the staff of the Political Section of the Secretariat of the League of Nations in Geneva. At the University of Algiers geography is represented by the eminent specialists in the geography of North Africa, Professors Augustin Bernard and E. F. Gautier. Professor Gautier is at present visiting professor at Harvard University. He addressed the joint meeting of the American Geographical Society and the Association of American Geographers this spring on "Native Life in French North Africa."

## Human Geography

In the field of human geography there have appeared two important works by Professor Jean Brunhes of the Collège de France, Paris, well known for his "La géographie humaine,"[43] one (jointly with Professor Camille Vallaux of the Ecole des Hautes Etudes Commerciales), "La géographie de l'histoire," a suggestive discussion of the geography of history, and the other, "Géographie humaine de la France," a preliminary volume on the human geography of France.[44] Professor Demangeon, too, has recently contributed a valuable paper in this domain, on the types of rural dwellings in France.[45] From the French school, it is understood, there may be expected in the not distant future a manual of human geography comparable to De Martonne's standard manual of physical geography. A fruitful field developed by the French is that of city geography, as witness the studies by Levainville of Rouen[46] and by Blanchard of Grenoble and Annecy.[47] A periodical was founded in 1919 by the Institut d'Histoire de Géographie et d'Economie Urbaines de la Ville de Paris, called *La Vie Urbaine*, in which papers of geographical interest appear, notably one by Louis Bonnier with a series of maps showing the growth of Paris progressively from 1800 to 1911,[48] and another on the northeastern section of Paris, with an airplane photographic map in 1 : 5,000.[49]

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[42] La République Argentine: La mise en Valeur du pays, Paris, 1920 (reviewed in *Geogr. Rev.*, Vol. 11, 1921, pp. 148–149).

[43] Recently made available to English-speaking students by Isaiah Bowman and R. E. Dodge in "Human Geography," Chicago, 1920.

[44] For reviews see —— of the former: Douglas Johnson: The Geography of History: A Review, *Geogr. Rev.*, Vol. 12, 1922, pp. 278–293; of the latter: *Geogr. Rev.*, Vol. 11, 1921, pp. 430–433, and the forceful discussion by Camille Vallaux: Rivières, pays, et maisons de France, *La Géogr.*, Vol. 35, 1921, pp. 113–126.

[45] A. Demangeon: L'habitation rurale en France: Essai de classification des principaux types, *Ann. de Géogr.*, Vol. 29, 1920, pp. 352–375.

[46] J. Levainville: Rouen: Étude d'une agglomération urbaine, Paris, 1913.

[47] Grenoble: Étude de géographie urbaine, 2nd edit., Paris, 1913; Annecy: Esquisse de géographie urbaine, *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 4, 1916, pp. 369–463.

[48] La population de Paris en mouvement, 1800–1911, No. 1–2, 1919, pp. 7–76; Cartes isochrones de l'agglomération parisienne, No. 3, pp. 245–250.

[49] Myriem Foncin: Belleville, No. 11, Dec. 5, 1921, pp. 391–415.

## Other Work of Interest

Among other outstanding developments of interest should be mentioned the publication of the Service Géographique de l'Armée "Notices"[50] and the excellent Travaux du Comité d'Études,[51] both series, like their previously mentioned British counterparts, preparatory reports for the peace conference on the problem areas of the world; the centenary of the Paris Geographical Society, celebrated on July 4–7, 1921, under the auspices of its president, Prince Roland Bonaparte, and its secretary-general, Monsieur G. Grandidier, on which occasion a valuable history of this oldest of all geographical societies was published;[52] and, in the field of exploration, Commandant Tilho's renewed work in the Tibesti upland region of the east-central Sahara.[53]

The war work of the Service Géographique de l'Armée is discussed in two articles,[54] one by General Bourgeois, its former head. Of foremost interest are the "plans directeurs," mainly in 1 : 20,000, a series of maps, now first made available to the public, which cover the whole eastern frontier region of France. The sheets relating to the French Alps, because of their unusually large scale, afford an exceptionally valuable tool for the study of an alpine region. Of like value are the relief models in 1 : 20,000, with no vertical exaggeration, which have been made sheetwise out of this series for the whole war area from the North Sea to Switzerland. The appearance is striking of a set of the models when put together to cover a type region such as the Vosges or the eastern cuestas of the Paris Basin. Another cartographical undertaking of importance is the appearance of a new edition of the "Atlas Universel de Géographie" under the direction of the veteran geographer, Monsieur F. Schrader. In the new edition greater legibility is attained by representing relief in a different color from the line element. The valuable physical maps of the continents have been retained from the previous edition.

## Germany

Germany emerges from the war with two more universities than she had before: three are newly established, Frankfort (1914), Cologne (1919), and Hamburg (1919), and one, Strasbourg, has been lost. Geography is represented by at least one full professorship at each of her universities, now twenty-three in number. An authentic count[55] of all the instructors of

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[50] Notices descriptives et statistiques, Commission de Géographie du Service Géographique de l'Armée et 2e Bureau de l'État-Major de l'Armée. For list see *La Géogr.*, Vol. 33, 1920, pp. 355–356.

[51] For titles see *La Géogr.*, Vol. 33, 1920, pp. 149–154; Vol. 34, 1920, pp. 286 (last item), 289–298, *passim*, 308–311 (maps); Vol. 36, 1921, p. 104 (third item).

[52] Centenaire de la Société de Géographie, 1821–1921, 72 pp., Paris, 1921 (republished with an account of the centenary as an 151-pp. book, Paris, 1921, and in *La Géogr.*, Vol. 36, 1921, No. 2). Cf. also Notice sur la Société de Géographie, 91 pp., Paris, 1914, and note in *Geogr. Rev.*, Vol. 12, 1922, p. 143.

[53] *Geogr. Journ.*, Vol. 56, 1920, pp. 81–99, 161–183, 241–267, with map in 1:2,000,000; also *La Géogr.*, Vol. 36, 1921, pp. 295–317.

[54] Le Service Géographique de l'Armée et la cartographie de guerre, *La Géogr.*, Vol. 32, 1918–19, pp. 463–484; [J. E. R.] Bourgeois: Le Service Géographique de l'Armée pendant la guerre, *Revue Scientifique*, Nov. 27, 1920, pp. 673–684. Cf. also note "Nouvelles cartes et plans en relief de France," *Ann. de Géogr.*, Vol. 30, 1921, pp. 149–150.

geography at her universities and higher technical schools[55]—full professors, associate professors, and *privatdozenten*—reveals the formidable number of 70. The subject of investigation of these men is specifically geography. They are not geologists or historians called geographers. They often specialize, of course, in some branch of our subject, and some of the very few remaining of the oldest generation have come to it from other sciences, but all, it may be said, consider the totality of geography as their field and feel it their duty to be proficient in it. Granted the high standard—in spite of its weaknesses—of scientific work in Germany, it is in this matter of the number of its professional geographers—men with the distinctive point of view which is the essence of modern geography—and the consequent large production of truly geographical literature, that Germany's strength lies.

## New Works in General Geography

Owing to this number of workers and owing also, partly, to a conscious division of labor, work is being done in Germany, it may be said, in practically every branch of general geography and on all important regions of the world. The following brief survey can, among the wealth of material, only touch upon some of the more outstanding or typical investigations that have been undertaken recently. In the field of *paleogeography* Dr. Alfred Wegener of the Deutsche Seewarte and the University of Hamburg has in a recent second edition of his book[56] amplified his migration hypothesis of continental origins, an hypothesis that has been widely discussed[57] and that seems to find confirmation in J. P. Koch's work in Greenland and W. Köppen's investigations of isostasy and pole migrations.[58] In *physiography* Professor Passarge of Hamburg has added the third volume, on the development of landforms, to the first (on landscape description) and second (on climatic, vegetational, and animal influences on the landscape) of his four-volume "Die Grundlagen der Landschaftskunde."[59] More concisely, and in a philosophic spirit, Professor Hettner of Heidelberg has recently discussed the evolution of landforms in a book[60] which gathers together and amplifies essays that had appeared in the *Geographische*

[55] Geographische . . . Vorlesungen in deutscher Sprache an den Hochschulen Mitteleuropas im Winterhalbjahr 1921–22, *Petermanns Mitt.*, Vol. 67, 1921, pp. 260–262 (geographers at German universities, 53; at German technical schools, 17; at Austrian universities and technical schools, 15; at German Swiss universities and technical schools, 5).—As to the cultural unity of the German-speaking lands see p. 464. On the general topic indicated in its title see J. Russell Smith: Geography in Germany, II: The University, *Journ. of Geogr.*, Vol. 1, 1902, pp. 448–457.

[56] A. Wegener: Die Entstehung der Kontinente und Ozeane (in series: Die Wissenschaft, Vol. 66), Brunswick, 1920.

[57] *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1921, pp. 89–143 (statement and summing up by Wegener, discussion by four specialists).

[58] W. Köppen: Über Isostasie und die Natur der Kontinente, *Geogr. Zeitschr.*, Vol. 25, 1919, pp. 39–48; Polwanderungen, Verschiebungen der Kontinente, und Klimageschichte, *Petermanns Mitt.*, Vol. 67, 1921, pp. 1–8 and 57–63, with Pl. 1; Ursachen und Wirkungen der Kontinentenverschiebungen und Polwanderungen, *ibid.*, pp. 145–149 and 191–194.

[59] Die Grundlagen der Landschaftskunde: Vol. 1, Beschreibende Landschaftskunde, 210 pp., Hamburg, 1919 (reviewed by W. M. Davis in *Geogr. Rev.*, Vol. 8, 1919, pp. 266–273); Vol. 2, Klima, Meer, Pflanzen- und Tierwelt in der Landschaft, 222 pp., Hamburg, 1920; Vol. 3, Die Oberflächengestaltung der Erde, 558 pp., Hamburg, 1920. Vol. 4, Der Mensch in der Landschaft, is announced for publication later.

[60] Die Oberflächenformen des Festlandes: Ihre Untersuchung und Darstellung, 250 pp., Leipzig, 1921.

*Zeitschrift.* Frankly critical of Professor Davis' views, the works of these two authors at least show to what extent those views roused and stimulated geographic thought in Germany. Of the German version of Professor Davis' "Physical Geography" a second edition in two volumes has appeared;[61] likewise the first German edition of his "Practical Exercises in Physical Geography."[62] Of Supan's standard textbook of physical geography a sixth edition appeared in 1916.[63] Supan's importance in the development of modern geography in Germany is dwelt upon in two appreciations that appeared at the time of his death in 1920.[64] Attention may also be called to a book on the relation between geological structure and surface features by Professor Karl Sapper, of the University of Würzburg, known for his work in Central America.[65] Of *manuals of general geography* new editions have appeared of part of the standard "Lehrbuch der Geographie"[66] by Professor Hermann Wagner, dean of German geographers and still active at the age of 82,[67] and of the concise and well-balanced textbook[68] by Professor W. Ule of Rostock. An entirely new work is the manual of general geography by Professor A. Philippson, one of the leading geographers of Germany, of which the first part, dealing with mathematical geography and climatology, has just appeared.[69] A valuable feature is a new classification of climatic types and climatic provinces, in text and maps. In the field of *oceanography* there should be mentioned a valuable paper on an hitherto little known region from this point of view, the Persian Gulf.[70] The author, Dr. Gerhard Schott of the Deutsche Seewarte in Hamburg. quickly followed it with a complete geographical discussion of the area,[71] similar in treatment to his admirable "Geographie des Atlantischen Ozeans." In *climatology* Professor L. Mecking of the University of Münster establishes a North Atlantic "see-saw" (*nordatlantische Wärmeschaukel*) from a study of the opposite effect on both sides of the North Atlantic of sun spot frequency (sun spot maximum, lowering of mean annual temperature on American side, raising on European, and vice versa).[72] With Köppen's

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[61] W. M. Davis and Gustav Braun: Grundzüge der Physiographie, 2 vols.: Vol. 1, Grundlagen und Methodik, Leipzig, 1917; Vol. 2, Morphologie, Leipzig, 1915.

[62] W. M. Davis and Karl Oestreich: Praktische Übungen in physischer Geographie, Leipzig, 1918.

[63] Grundzüge der physischen Erdkunde, Leipzig, 1916.

[64] Hermann Wagner: Alexander Supan, *Petermanns Mitt.*, Vol. 66, 1920, pp. 139–146; Bruno Dietrich: Alexander Supan, *Geogr. Zeitschr.*, Vol. 27, 1921, pp. 193–198.

[65] Geologischer Bau und Landschaftsbild (in series: Die Wissenschaft, Vol. 61), Brunswick, 1917 (reviewed in *Geogr. Rev.*, Vol. 11, 1921, pp. 315–317).

[66] Lehrbuch der Geographie, Vol. 1: Allgemeine Erdkunde, Part 1: Einleitung, Mathematische Geographie, 10th edition, Hanover, 1920. Part 2 is in press. The 9th edition of the whole of Vol. 1 appeared in 1912.

[67] See address on his 80th birthday on retirement from chair of geography at University of Göttingen and bibliography (273 titles), *Petermanns Mitt.*, Vol. 66, 1920, pp. 115–122.

[68] Grundriss der allgemeinen Erdkunde, 2nd edition, Leipzig, 1915.

[69] A. Philippson: Grundzüge der allgemeinen Geographie. Vol. 1, Einleitung; Mathematische Geographie; Atmosphärenkunde, 270 pp., Leipzig, 1921.

[70] Ozeanographie und Klimatologie des Persischen Golfes und des Golfes von Oman, 46 pp., Beilage zu *Ann. der Hydrogr. und Marit. Meteorol.*, 1918.

[71] Geographie des Persischen Golfes und seiner Randgebiete, *Mitt. Geogr. Gesell. Hamburg*, Vol. 31, 1918, pp. 1–110, with two maps, one in 1 : 4,000,000.

[72] Nordamerika, Nordeuropa, und der Golfstrom in der elfjährigen Klimaperiode, *Ann. der Hydrogr. und Marit. Meteorol.*, Vol. 46, 1918, pp. 1–9, with temperature and sun-spot frequency curves on Pl. 1.

new climatic provinces[73] readers of the *Review* are already familiar; their areas have recently been measured.[74] Köppen has also recently delimited the wind regions of the world, particularly over the ocean.[75] Noteworthy in *plant geography* are a general discussion of the tundra by Dr. A. Jacobi[76] and a map by Dr. E. Ihne, the well-known phenologist, showing the date of the beginning of spring in the British Isles[77] based on the regular phenological observations in the *Quarterly Journal of the Royal Meteorological Society*. It is an extension of his earlier map of Central Europe.[78] In the field of *human geography* the most important recent publication is Supan's manual of political geography,[79] which discusses the principles of this important branch. A related work is the book[80] by Professor Karl Dove of the University of Freiburg, which deals more with the world-regional aspect of the subject, however. An example of the studies in the history of settlement in which Professor O. Schlüter of Halle specializes is his paper on natural conditions in East Prussia before the incursion of the Teutonic Order.[81] He also discusses the method of population density maps[82] as an introduction to a map of the Rhineland by one of his pupils. The fourth in a series of population density maps covering India,[83] important because relating to the one of the two Asiatic foci for which census statistics exist, has been published. They are products of the geographical seminar in Göttingen. A discussion of man's distribution over the earth[84] by Professor Norbert Krebs of the University of Freiburg, known for his excellent regional geography of the Austrian Alps, constitutes a complete but concise manual of human geography. Professor Dove has also written concise but original manuals of economic and commercial geography.[85] In the field of agricultural geography three atlases[86] have appeared, two by Dr. T. H.

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[73] Klassifikation der Klimate nach Temperatur, Niederschlag, und JahresVerlauf, *Petermanns Mitt.*, Vol. 64, 1918, pp. 193–203 and 243–248, With map, globular scale, 1 : 60,000,000 (see R. DeC. Ward: A New Classification of Climates, *Geogr. Rev.*, Vol. 8, 1919, pp. 188–191, With map).

[74] H. Wagner: Die Flächenausdehnung der Köppenschen Klimagebiete der Erde (1918), *Petermanns Mitt.*, Vol. 67, 1921, pp. 216–217.

[75] Die Windgebiete der Weltmeere, *Ann. der Hydrogr. und Marit. Meteorol.*, Vol. 49, 1921, pp. 357–359, With map in Mercator's projection, equatorial scale, 1 : 100,000,000.

[76] Die Tundra, *Geogr. Zeitschr.*, Vol. 25, 1919, pp. 245–262.

[77] Phänologische Karte des Frühlingseinzugs auf den Britischen Inseln, *Petermanns Mitt.*, Vol. 62, 1916, pp. 81–85, With map in 1 : 5,000,000.

[78] Pl. 9, *Petermanns Mitt.*, Vol. 51, 1905, scale 1 : 3,400,000.

[79] Leitfaden der allgemeinen politischen Geographie, 140 pp., Leipzig, 1918.

[80] Allgemeine politische Geographie, 95 pp. (in series: Sammlung Göschen, No. 800), Leipzig, 1920.

[81] Wald, Sumpf, und Siedelungsland in Altpreussen vor der Ordenszeit, *Geogr. Anzeiger*, Vol. 21, 1920, pp. 245–249, With map in 1 : 500,000.

[82] Grundsätzliche Bemerkungen über Volksdichtekarten, *Petermanns Mitt.*, Vol. 66, 1920, pp. 128–129 (map of Rhineland on Pl. 24, text pp. 159–161).

[83] *Petermanns Mitt.*, as follows: NorthWest ProVinces, 1 : 3,000,000, 1909, Pl. 18; Upper Gangetic Plain, 1 : 2,500,000, 1911, Pl. 33; Bombay ProVince, 1 : 2,500,000, 1916, Pl. 33; Southern India, 1 : 2,500,000, 1917, Pl. 32.

[84] Die Verbreitung des Menschen auf der Erdoberfläche (in series: Natur und GeistesWelt, No. 632), Leipzig, 1921.

[85] Allgemeine Wirtschaftsgeographie; Allgemeine Verkehrsgeographie (in series: Sammlung Göschen, Nos. 835 and 834), Leipzig, 1921.

[86] F. Lange: LandWirtschaftlich-Statistischer Atlas, 105 maps, Berlin, 1917; T. H. Engelbrecht: Die Feldfrüchte Indiens in ihrer geographischen Verbreitung, text and atlas, *Abhandl. Hamburg. Kolonialinst.*, Vol. 19,

Engelbrecht, known for his study of the geographical distribution of the price of cereals in North America and India.

## Papers Relating to the Development of Geography in Germany

Several publications relating to the development and status of geography in Germany are of interest. In a series of lectures in Berlin on the position of certain subjects in education geography was included. The lectures on geography, ten in number, by different specialists, have been published.[87] They include such topics as the unity of geography, by Hettner; geomorphology, by Philippson; plant and animal geography, by Professor R. Gradmann of the University of Erlangen, and the importance of maps, by Professor Norbert Krebs. Three papers deal with Richthofen, Theobald Fischer, and Kirchhoff as university teachers,[88] two with the courses given at Göttingen and Bonn,[89] while three memorial volumes[90] give an insight into the work of the pupils of Professors Penck, Hettner, and Eduard Hahn. The editor's retrospect over twenty-five years of the *Geographische Zeitschrift*,[91] which has had a marked influence on the development of geographic thought in Germany, may also be mentioned here. The standard German bibliography, the *Geographisches Jahrbuch*, has resumed publication, a volume having appeared which covers the war period.[92]

## War Publications

Only to certain outstanding war publications can reference here be made. At the beginning of the war a series of articles by leading geographers was published in the *Geographische Zeitschrift;* these were afterwards issued separately, somewhat revised.[93] Professor Philippson discussed the Franco-Belgian area, Professor Partsch of Leipzig the eastern front, Professor Krebs the Balkan front, Professor F. Frech of Breslau the Armenian and Mesopotamian area, Professor Mecking the Channel, the North Sea, and the

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1914; *idem:* Landwirtschaftlicher Atlas des Russischen Reiches in Europa und Asien, 30 maps, Berlin, 1916.

[87] Die Geographie als Wissenschaft und Lehrfach: Zehn geographische Abende im Zentralinstitut für Erziehung und Unterricht, Berlin, 1919.

[88] A. Philippson: Ferdinand von Richtofen als akademischer Lehrer, *Geogr. Zeitschr.*, Vol. 26, 1920, pp. 257–272; Alfred Rühl: Theobald Fischer als akademischer Lehrer, *ibid.*, Vol. 27, 1921, pp. 29–33; Hans Steffen: Erinnerungen an Alfred Kirchhoff als Methodiker der Geographie und als Universitätslehrer, *ibid.*, Vol. 25, 1919, pp. 289–302.

[89] Hermann Wagner: Der geographische Universitätsunterricht in Göttingen, *ibid.*, Vol. 25, 1919, pp. 1–20 and 97–106; A. Philippson: Die Geographie an der Universität Bonn, *Die Naturwissenschaften*, Vol. 7, 1919, pp. 561–571.

[90] Festband Albrecht Penck, Stuttgart, 1918 (reVieWed in *Geogr. Rev.*, Vol. 10, 1920, pp. 249–261); Zwölf länderkundliche Studien von Schülern Alfred Hettners ihrem Lehrer zum 60. Geburtstag, Breslau, 1921; Festschrift Eduard Hahn zum 60. Geburtstag, Stuttgart, 1917.

[91] Alfred Hettner: Fünfundzwanzig Jahre "Geographische Zeitschrift," *Geogr. Zeitschr.*, Vol. 26, 1920, pp. 1–8.

[92] Vol. 38 for 1915–18, Gotha, 1918–20.

[93] A. Hettner, edit.: Die Kriegsschauplätze, Leipzig, 1915–18.

Baltic. During the German occupation of Poland a Geographical Commission was appointed under the direction of Professor M. Friederichsen of the University of Königsberg, later of Dr. E. Wunderlich, at present at the School of Technology in Stuttgart on leave of absence from the University of Berlin. After preliminary publications, which included a discussion of each aspect of Russian Poland's geography, culminating in its division into natural regions,[94] a handbook was issued which constitutes a scientific regional geography of the area.[95] This was followed by a series of separate monographs, a number of which, on the vegetation of Russian Poland, on the cities of Poland and Lithuania, on the geographical source material on Poland, etc., were published[96] and others projected. Of none of the other areas occupied by the Germans was so systematic an investigation undertaken, partly because of the march of events, although Geographical Commissions were appointed in Rumania and Macedonia. Nevertheless good geographical work was carried out, as by Dr. W. Behrmann of Berlin in Rumania[97] and Dr. Walther Penck, who for a time was professor of geography at the University of Constantinople, in the Bosporus region and Asia Minor.[98] Professor Friederichsen had preceded his Polish work by an excellent little book on the marginal regions of Russia.[99] The campaigns in German Southwest Africa[100] and German East Africa[101] have been discussed from the geographical standpoint. Several articles deal with war mapping and its geographical bearing.[102] An important work which had been prepared by the German War Office before the war, but which was only released to the public after the conflict, is a contoured topographic map on the scale of 1 : 100,000 in 326 sheets of Russian Poland and the Baltic Provinces.[103] It was based on a Russian map not made public in 1 : 42,000 and 1 : 84,000, reductions of the original plane table sheets in

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[94] E. Wunderlich, K. Siche, F. Pax, Ferdinand Pax, Arved Schultz, H. Praesent: Die natürliche Gliederung Polens, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1917, pp. 269–310 and 446–456.

[95] E. Wunderlich, edit.: Handbuch von Polen (Kongress-Polen): Beiträge zu einer allgemeinen Landeskunde, 2nd edit., Berlin, 1918 (reVieWed in *Geogr. Rev.*, Vol. 9, 1920, pp. 215–216).

[96] Veröffentlichungen der Landeskundlichen Kommission beim Kaiserlich Deutschen GeneralgouVernement Warschau: Beiträge zur Polnischen Landeskunde: Reihe A (FachWissenschaftliche Monographieen als Ergänzungen zum Handbuch), No. 1; Reihe B (Für Weitere Kreise bestimmte Einzelschriften), Nos. 1–6, Berlin, 1917–18.

[97] Die Landschaften Rumäniens, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1919, pp. 29–45, With phYsiographic map.

[98] E. g. Grundzüge der Geologie des Bosporus, *Veröffentl. Inst. für Meereskunde Univ. Berlin; N. F., Geogr.-naturwiss. Reihe No. 4*, Berlin, 1919; Bau und Oberflächenformen der Dardanellenlandschaft, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1917, pp. 30–49; Zur Landeskunde von Thrazien, *ibid.*, 1919, pp. 358–370.

[99] Die Grenzmarken des Europäischen Russlands: Ihre geographische Eigenart und ihre Bedeutung für den Weltkrieg, Hamburg, 1915 (reVieWed in *Geogr. Rev.*, Vol. 1, 1916, pp. 473–474).

[100] Fritz Jaeger: Deutsch SüdWest-Afrika als Kriegsschauplatz, *Geogr. Zeitschr.*, Vol. 26, 1920, pp. 201–206.

[101] E. Krenkel: Der ostafrikanische Kriegsschauplatz, *ibid.*, pp. 105–117, With map; Gov. Schnee: Deutsch-Ostafrika Während des Weltkrieges, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1919, pp. 1–17.

[102] Max Eckert: Die Kartographie im Kriege, *Geogr. Zeitschr.*, Vol. 26, 1920, pp. 273–286, 316–324, Vol. 27, 1921, pp. 18–28; *idem:* Luftbildaufnahme und Kartenherstellung, *ibid.*, Vol. 27, 1921, pp. 241–260; E. Fels: Das Kriegsvermessungswesen in Dienste der Geographie, *Petermanns Mitt.*, Vol. 65, 1919, pp. 81–89; E. Ewald: Die Flugzeugphotographie im Dienste der Geographie, *ibid.*, Vol. 66, 1920, pp. 1–6.

[103] Karte des Westlichen Russlands, 1 : 100,000, 326 sheets. Bearbeitet von der Kartographischen Abteilung der Landesaufnahme. Index map in 1 : 2,750,000, in catalogue entitled "Karten und Wissenschaftliche Veröffentlichungen der Landesaufnahme," Berlin, 1920. Sections from this map will be found in "Handbuch von Polen," 2nd edit., Pls. 1, 2, 4, 5, 7.

1 : 21,000,[104] and formed a direct continuation, on the same scale, of the topographic map of Germany. It is understood that both armies, the Russian and the German, fought by it, the former by the original, the latter by the recompilation.

## Work in Regional Geography

In the field of regional geography several systematic works may be mentioned. With different emphasis Professors W. Ule and Gustav Braun have treated the geography of Germany.[105] In a shorter work on a related topic[106] Professor Braun has outlined the methods followed in the larger book. In the model series of regional geographies edited by Professor Penck, which began with Professor Krebs's excellent book on the Austrian Alps,[107] a second volume has appeared, by Professor Machatschek of Prague, on Russian Turkestan (see footnote 382). Volumes are contemplated, it is understood, on the East Indies by Professor W. Volz of Breslau, on the Aegean region by Professor Philippson, and on the Low Countries by Professor Oestreich of Utrecht. Professor Hettner, always a strong advocate of regional geography as the main aim of geographical investigation—a conviction shared by the majority of leading geographers of Germany—will soon publish the section on Asia in his standard "Grundzüge der Länderkunde." At the same time abridged editions of this and the previously published section on Europe will appear. His geography of Russia, originally published in 1905, has appeared much enlarged in a third edition.[108] Early in the war Professor Philippson published a brief geography of Turkey[109] which has been characterized as exemplary. He has recently published a series of maps in 1 : 900,000, with notes, summarizing the results of his comprehensive studies in western Asia Minor. They show relief, physiography, vegetation, and ethnography.[110] In this connection mention should be made of a map of Asiatic Turkey, with substantiating text, showing the status of topographical knowledge of that area in 1914.[111] It shows in greater detail, both as to quality of survey and scale, what was represented on an

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[104] Handbuch von Polen, 2nd edit., pp. 24–25.

[105] W. Ule: Das Deutsche Reich: Eine geographische Landeskunde, Leipzig, 1915; G. Braun: Deutschland, dargestellt auf Grund eigener Beobachtung, der Karten, und der Literatur, 1 vol. text, 1 vol. maps and diagrs., Berlin, 1916 (reviewed in *Geogr. Rev.*, Vol. 10, 1920, pp. 52–53).

[106] Mitteleuropa und seine Grenzmarken: Ein Hilfsbuch für geographische Studien und Exkursionen (in series: Wissenschaft und Bildung, No. 141), Leipzig, 1917.

[107] Länderkunde der österreichischen Alpen, Stuttgart, 1913 (reviewed in *Geogr. Rev.*, Vol. 2, 1916, pp. 317–319).

[108] Russland: Eine geographische Betrachtung von Volk, Staat, und Kultur: Dritte erweiterte Auflage des Werkes "Das europäische Russland," Leipzig, 1916.

[109] Das türkische Reich: Eine geographische Übersicht (in series: Deutsche Orient Bücherei, No. 12), Weimar, 1915.

[110] In *Petermanns Mitt.*, as follows: relief in altitude tints, Vol. 67, 1921, Pl. 9 (text p. 123); physiography, Vol. 66, 1920, Pl. 31 (text, pp. 197–202); vegetation, Vol. 65, 1919, Pl. 18 (text, pp. 168–173, 204–207); ethnography, *ibid.*, Pl. 3 (text pp. 17–19).

[111] H. Fischer: Geschichte der Kartographie von Vorderasien, *Petermanns Mitt.*, Vol. 66, 1920, pp. 82–89, 164–166, 203–205, 219–225, with map in 1 : 3,700,000.

earlier map by Dr. Hogarth.[112] A considerable portion of the area correctly marked on the present map as unexplored or based on reconnaissance maps only, especially in Armenia and Kurdistan, has since been covered by the valuable contoured topographic map in 1 : 200,000, based on original surveys, which was published by the Turkish General Staff during the war. Germany's interest in the geography of her Near Eastern ally is further betokened by a book by E. Banse,[113] with which readers of the *Review* are familiar from its division of the area into natural regions, and by one by Professor Kurt Hassert of the Polytechnic Institute of Dresden, which emphasizes the economic geography.[114] Among a younger group of geographers who have specialized in certain regions from personal observation may be mentioned Professor F. Thorbecke of the University of Cologne, the publication of the results of whose travels in Cameroons have recently been completed;[115] Dr. Leo Waibel, also of Cologne, who has caught the spirit of the South African veld;[116] Dr. Arved Schultz, who knows the Pamir and Turkestan;[117] and Dr. Richard Pohle, who deals with Eastern Europe and Siberia.[118] The late Professor Emil Deckert of the University of Frankfort contributed two studies during the war in his special field, the economic geography of the Anglo-Saxon world.[119] Professor Hassert has also recently written an economic geography of the United States,[120] in the preparation of which he had the assistance of Dr. Martha Krug Genthe, the German geographer who lived for a time in the United States. Of the geography of South America by Professor W. Sievers of the University of Giessen, the leading German authority on that subject, who died in June 1921,[121] a third edition appeared in 1911.[122] A new (tenth) edition of Stieler's atlas is in preparation[123] which involves a thorough revision;

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[112] D. G. Hogarth: Problems in Exploration: I, Western Asia, *Geogr. Journ.*, Vol. 32, 1908, pp. 549–570, With map in 1 : 10,000,000.

[113] Die Türkei: Eine moderne Geographie, With map in 1 : 5,000,000, BrunsWick, 1919 (see E. C. Semple: The Regional Geography of Turkey: A ReVieW of Banse's Work, *Geogr. Rev.*, Vol. 11, 1921, pp. 338–350, With map, 1 : 7,000,000).

[114] Das Türkische Reich, politisch, geographisch, und Wirtschaftlich, Tübingen, 1918.

[115] Im Hochland von Mittel-Kamerun, in 3 parts, *Abhandl. Hamburg. Kolonialinst.*, Vols. 21, 36, 41, Ham burg, 1914, 1916, 1919. See also his Das tropische West- und Mittel-Afrika, *Geogr. Zeitschr.*, Vol. 21, 1915 pp. 372–394 and 443–453.

[116] Der Mensch im südafrikanischen Veld, *Geogr. Zeitschr.*, Vol. 26, 1920, pp. 26–50 and 79–89; see also his book UrWald, Veld, Wüste, 206 pp., Breslau, 1921.

[117] E.g. Landeskundliche Forschungen in Pamir, *Abhandl. Hamburg. Kolonialinst.*, Vol. 33, 1916; Die natürlichen Landschaften von Russisch Turkestan, *Abhandl. aus dem Gebiet der Auslandskunde, Hamburg. Univ.* (continuation of preceding series), Vol. 2, 1920 (reVieWed in *Geogr. Rev.*, Vol. 12, 1922, pp. 151–152).

[118] R. Pohle and H. Heyde: Völkerkarte von Osteuropa, 1 : 6,000,000, Berlin, [1919]; R. Pohle: Beiträge zur Kenntnis der Westsibirischen Tiefebene, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1918, p. 1 ff., 1919, pp. 395–442; *idem:* Sibirien als Wirtschaftsraum, 66 pp., Bonn, 1921 (reVieWed in *Geogr. Rev.*, Vol. 12, 1922, pp. 149–151).

[119] Die Länder Nordamerikas in ihrer Wirtschaftsgeographischen Ausrüstung, Vienna, 1916; Das britische Weltreich: Ein politisch- und wirtschaftsgeographisches Charakterbild, Vienna, 1916.

[120] Die Vereinigten Staaten von Amerika als politische und Wirtschaftliche Weltmacht geographisch betrachtet, 315 pp., Tübingen, 1922.

[121] See biographical notice in *Petermanns Mitt.*, Vol. 67, 1921, p. 163.

[122] Süd- und Mittelamerika (in series: Allgemeine Länderkunde edit. by W. SieVers), 3rd edit., Leipzig, 1914 (revieWed in *Geogr. Rev.*, Vol. 6, 1918, p. 459).

[123] H. Haack: Die Hundertjahr-Ausgabe von Stielers Handatlas, *Petermanns Mitt.*, Vol. 67, 1921, pp. 19–22, With sample map on Pl. 3.

for instance, the sheets for the United States are being redrawn from reductions of the topographic sheets of the U. S. Geological Survey where available. A new (seventh) edition has also appeared of Andree's Handatlas; likewise Danish-Norwegian and Swedish editions.

## Post-War Arrangements

After a lapse of seven instead of the customary two years the twentieth Meeting of German Geographers was held in Leipzig in May, 1921.[124] The majority of the topics discussed in the papers presented have already, in mentioning the work of various geographers, been indirectly touched upon. Reference to several arrangements resulting from post-war conditions may, however, be of interest. For greater economy of effort and better co-operation a union of all the German and Austrian geographical societies has been created. Similarly, resolutions were passed to establish a central clearing house for foreign periodicals, from which each institution not receiving certain series and unable to subscribe for them may borrow the desired publications. As to German production, at least doctor's dissertations are curtailed for the present, as the universities have, because of the high cost, waived the requirement that they be printed. Another resolution passed calls on German map publishers to show the territories lost by Germany, including her former colonies, on all maps of the relevant areas, including school maps. In connection with the meeting there was an exhibition at the Deutsche Bücherei, a new library building which was built in 1913–16 to accommodate all publications in German from 1913 on. Two special publications deal with the map collection of the library and with the map exhibits prepared for the meeting.[125]

## Italy

Of two of the four countries of Europe which lead in geography we now have excellent modern accounts of the development of the subject: one, concise, on France, by Professor de Martonne, to which reference has already been made;[126] the other, somewhat fuller, on Italy, by Professor Roberto Almagià of the University of Rome.[127] Each contains an invaluable list of the most important contributions to geography produced in that country; the works thus grouped together for each country practically constitute the body of its modern geographic thought. Professor Almagià's book makes it unnecessary here even to outline Italy's development, so illuminating

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[124] For an account see P. Langhans and H. Degner: Die 20. Tagung des Deutschen Geographentages zu Leipzig in der Pfingstwoche, 1921, *Petermanns Mitt.*, Vol. 67, 1921, pp. 117–122 and 150–152.

[125] Hans Praesent, edit: Beiträge zur deutschen Kartographie, im Auftrage der Deutschen Bücherei herausgegeben, 160 pp., Leipzig, 1921; Geographische Ausstellung des Deutschen Buchgewerbevereins, mit Beiträgen zur Entwicklung des Hand- und Schulatlas, des Reisehandbuches, und des geographischen Schulbuches, 57 pp., Leipzig, 1921.

[126] Under "France," footnote 35.

[127] La geografia (series: Profili Bibliografici de l'Italia Che Scrive), 109 pp., Istituto per la Propaganda della Cultura Italiana, Rome, 1919.

and so encouraging for other countries that are striving to reach a higher status in our subject. Suffice it here to say that, as in France, this development centers mainly about one man, Giuseppe Dalla Vedova.[128] Like his French contemporary, Vidal de la Blache, he had the satisfaction of seeing his work carried on in the hands of his pupils—and these include the majority of the men who are advancing the subject in Italy today. He died in 1919 at the age of 85.[129] Another who helped usher in the new movement was Giovanni Marinelli (1846–1900),[130] known for his comprehensive compendium of general and regional geography ("La Terra," 8 vols., Milan, 1883–1901). The second volume of his collected papers, [131] on the geography of Italy and pedagogical questions, has recently appeared.

Geography is represented at twelve of Italy's universities. This practically constitutes the maximum number possible, as, in its modern aspect as a unit subject, it comes under the jurisdiction of the Faculty of Letters and, of the twenty-one Italian universities (including the four "free" universities), nine have no Faculty of Letters. One of the twelve (Parma) has no geography in the Faculty of Letters; the subject is there only represented as physical geography in the Faculty of Science. Except for this vacancy, geography enjoys maximum representation at the universities. In addition it is taught at several other higher institutions. This condition is indicative of the high state of development of geography in Italy.

## Geography in Rome

At the University of Rome Professor Almagià occupies the chair of geography.[132] He is a pupil of Dalla Vedova and has been productive in many branches of geography, but more particularly on the historical and human sides. He has written on the theory of tides in antiquity and the Middle Ages and dealt with the history of Italian cartography.[133] Among

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[128] A selection from his Works, With a complete list of his Writings to 1912 is given in: Giuseppe Dalla Vedova: Scritti geografici (1863–1913) scelti, coordinati, e ripubblicati a cura d'un comitato di geografici, Novara and Rome, 1914. His last Work should also be consulted: La geografia nella Vita e nella scuola moderna, *Nuova Antologia*, August, 1918. Some of the Work of his pupils is illustrated in the memorial Volume on the fiftieth anniversary of his career as a teacher: Scritti di geografia e di storia della geografia concernenti l'Italia pubblicati in onore di Giuseppe Dalla Vedova, Florence, 1908.

[129] For biographies see Filippo Porena: Giuseppe Dalla Vedova, *Geographen Kalender*, Vol. 5, 1907, Gotha, pp. 2–27; *idem:* L'Opera di Giuseppe Dalla Vedova, in the memorial Volume mentioned in the preceding footnote, pp. ix–xxxi; L. F. De Magistris: Giuseppe Dalla Vedova, 16 pp., *Calendario-Atlante De Agostini* for 1914, Novara, 1914; Roberto Almagià: Giuseppe Dalla Vedova, *Boll. Reale Soc. Geogr. Ital.*, Vol. 57, 1920. pp. 31–50.

[130] Cf. the biography by Attilio Mori, *Riv. Geogr. Didatt.*, Vol. 1, 1917, No. 1, in the series published by that journal on the leading geographers of the last fifty years.

[131] Scritti minori di Giovanni Marinelli: Vol. 1, Metodo e storia della geografia, Florence, 1908; Vol. 2, Geografia italiana e questione didattiche, Florence, 1921.

[132] On the geography department at Rome cf. Roberto Almagià: Il gabinetto di geografia della R. Università di Roma, 13 pp., Città di Castello, 1921. On his appointment to the chair in Rome see *La Geografia* (Novara), Vol. 4, 1916, pp. 146–147. The reports of the nominating committees there reproduced (pp. 140–147) from the official bulletin of the Ministry of Public Instruction give an insight into the Work of several of the leading geographers at the universities.

[133] La dottrina della marea nell'antichità classica e nel Medio Evo, 139 pp., *Mem. Reale Accad. Lincei: Classe Sci. Fis.*, Rome, 1905; La cartografia dell' Italia nel Cinquecento, *Riv. Geogr. Ital.*, Vol. 21, 1914, pp. 640–653; Vol. 22, 1915, pp. 1–26.

his recent publications are a succinct life of Columbus treated in a geographical manner,[134] and a paper on the content of human geography.[135] Lectures on meteorology are given at the university by Dr. Filippo Eredia of the Italian Meteorological Office, who has recently written on the climate of Tripoli and the rainfall of Palestine.[136] The representative of geography at the Normal School in Rome, Professor Assunto Mori, has made a distinctive contribution in publishing a systematic atlas in which the various elements of geography, such as relief, climate, human distribution, economic conditions are represented both as general phenomena and in their application to different regions. The volume so far published[137] covers general geography and western and southern Europe.

## Florence as a Geographical Center

Florence is one of the most important geographical centers in Italy. At the Institute of Higher Studies geography is represented by Professor Olinto Marinelli, son of Giovanni Marinelli, and known for his numerous and fruitful investigations. As joint editor, with Professor Attilio Mori of the University of Messina, of the *Revista Geografica Italiana*, he has exercised great influence on the development of modern geography in Italy. Of his numerous recent publications there can only be mentioned two physiographic studies,[138] several papers dealing with the conception of the natural region,[139] a paper on the peoples of the contact zone of northern Italy from Nice to the Quarnero,[140] an economic classification of cities,[141] and a history of the development of isometric lines, such as isotherms, etc.[142] Associated with Professor Marinelli are Professors Sebastian Crinò and Luigi Giannitrapani. Professor Crinò, author of an anthropogeographic study of Etna,[143] is the editor of a new journal devoted to the teaching of geography, *Rivista di Geografia Didattica*, which has appeared since 1917. A paper of his on the distribution of population over the earth[144] may be noted. Professor

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[134] Cristoforo Colombo (in series: Profili), 78 pp., Rome, 1918.

[135] La geografia umana, *La Geografia*, Vol. 4, 1916, pp. 366–387.

[136] Climatologia di Tripoli e Bengasi, *Monogr. e Rapp. Colon. No. 4*, Rome, 1917; Le precipitazioni acquee in Palestina, *Boll. Reale Soc. Geogr. Ital.*, Vol. 57, 1920, pp. 259–270.

[137] Atlante di geografia fisica, politica, ed economica: Fascicolo 1, 18 plates with over 300 maps and diagrs., Turin, etc., 1918.

[138] La regione del Monte Amiata, *Mem. Geogr. No. 39*, Florence, 1919; Fenomeni carsici nelle regione gessose d'Italia, *ibid. No. 34*, 1917.

[139] Sul concetto di regione naturale, *Riv. Geogr. Didatt.*, Vol. 4, 1920, No. 5; Il Friuli come tipo di regione naturale, *ibid.*, Vol. 1, 1917; Sopra le regioni ed i confini naturali con particolari cenni relativi all'Italia, Appendix 1 (pp. 114–122) to a general paper on the geographical situation in Italy: La geografia in Italia, *Riv. Geogr. Ital.*, Vol. 23, 1916, pp. 1–24 and 113–131.

[140] The Regions of Mixed Populations in Northern Italy, *Geogr. Rev*, Vol. 7, 1919, pp. 129–148, with ethnographic map, 1 : 1,500,000.

[141] Dei tipi economici dei centri abitati a proposito di alcune città italiane ed americane, *Riv. Geogr. Ital.*, Vol. 23, 1916, pp. 413–431.

[142] Appunti storici e didattici sulle curve isometriche, *Riv. Geogr. Didatt.*, Vol. 4, 1920, No. 6; Vol. 5, 1921, No. 1.

[143] L'Etna: Saggio antropogeografico, 28 pp., Messina, 1907.

[144] Osservazioni intorno alla distribuzione della popolazione sulla superficie terrestre, *Riv. Geogr. Didatt.*, Vol. 1, 1917.

Giannitrapani, author of a regional monograph on Savoy,[145] has dealt with the methods of study of regional geography.[146] Florence is also the headquarters of the Istituto Geografico Militare, which, under the energetic direction of General N. Vacchelli, is making valuable contributions to geography even beyond its regular output of topographic and other maps. In 1920 this office began the publication of a monthly journal called *L'Universo*, which contains geographical articles of general interest, more especially dealing with mapping. Among articles of the latter type, for example, has appeared one on material of such relatively difficult access as the topographic maps of Turkey.[147] This appropriateness of Florence made it the city that was chosen for the eighth Italian Geographical Congress, which was held there from March 29 to April 23, 1921.[148] No congress had been held since 1910, in Palermo. Dr. F. de Filippi spoke on the publication of the results of the Duke of Abruzzi's expedition to the Karakorum.[149] Count Cesare Calciati, who is a pupil of Professor Girardin of Fribourg, Switzerland, reported on his recent glacial studies during the expedition to the Himalayas under the auspices of M. Piacenza.[150] Professor Marinelli outlined the plan of a comprehensive physical and anthropological atlas of Italy, and the Italian Touring Club, well known for the publication of an admirable map of Italy in 1 : 250,000 and detailed provincial guide books of Italy, exhibited the first sheets of the large general atlas which it is bringing out.[151]

## Other University Geographers

Among other leading geographers at the universities should be mentioned Professor Giotto Dainelli of Pisa, editor of *Memorie Geografiche*, the series of monographs supplementary to the *Revista Geografica Italiana*, to which he has himself recently contributed an excellent discussion, valuable from the standpoint of method, of population distribution in Tuscany,[152] besides publishing a regional study of Dalmatia with accompanying atlas;[153] Professor Carlo Errera of the University of Bologna, known for his history of the age of discovery, who has recently studied the Italian-Slav contact zone on the eastern side of the Adriatic[154] and published an excellent concise

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[145] La Savoia: 'Monografia geografica,' *Boll. Reale Soc. Geogr. Ital.*, Vol. 52, 1915, pp. 31–68.

[146] Il metodo negli studi di geografia regionale, *Riv. Geogr. Ital.*, Vol. 26, 1919, pp. 1–27. See also his: Monografie regionali, *Riv. Geogr. Didatt.*, Vol. 1, 1917, No. 4.

[147] Il Servizio Topografico nell' Impero Ottomano e la moderna cartografia turco, *L'Universo*, Vol. 1, 1920, pp. 127–136, with several maps, including indexes of the 1 : 25,000–50,000 and 1 : 200,000 series (cf. p.448, top).

[148] *Riv. Geogr. Ital.*, Vol. 28, 1921, pp. 1–8; Roberto Almagià, *Petermanns Mitt.*, Vol. 67, 1921, p. 129.

[149] La spedizione nel Karakorum e nell' Imalaja occidentale, 1909: Relazione dell Dott. Filippo de Filippi, illustr. di Vittorio Sella, 1 vol. text and case of panoramas and maps, Bologna, 1920).

[150] Cesare Calciati: Cenno sui risultati geografici della spedizione Mario Piacenza in Himalaja, Milan, 1921, with map, 1 : 100,000, of glaciers explored.

[151] R. Almagià: Un grande atlante geografico italiano, *Riv. Geogr. Ital.*, Vol. 24, 1917, pp. 353–357; L. V. Bertarelli: L'attività geografica del Touring Club Italiano nel decennio 1910–20; Il grande Atlante Internazionale del T. C. I. (Nota per l'VIII Congr. Geogr. Ital.), 32 pp., Florence, 1921.

[152] La distribuzione della popolazione in Toscana, *Mem. Geogr. No. 33*, 260 pp., Florence, 1917, with 3 maps showing population in relation to area and altitude, and the location and size of agglomerations.

[153] La Dalmazia, 1 vol. text, 73 pp., and atlas of 22 plates with 60 maps, Novara, 1918.

[154] Italiani e Slavi nella Venezia Giulia, *Quaderni Geogr. No. 9*, Novara, 1918; La lingua dei pubblici uffici nei comuni dalmati trent' anni fa, *Riv. Geogr. Ital.*, Vol. 27, 1920, pp. 47–53.

account of Italy and its regions;[155] Professor Arrigo Lorenzi of Padua, whose latest anthropogeographical study deals with man and the forest,[156] and Professor Luigi De Marchi of the same university, who has recently added a concise manual of physical geography[157] to his earlier comprehensive treatise on that subject[158] and written a valuable discussion of the karst hydrography of the Asiago Plateau;[159] Professor Attilio Mori of Messina, who deals with population distribution in Sicily;[160] Professor C. Colamonico of Naples, who has made intensive studies of the population of the provinces of Puglia and Lecce in relation to elements of physical geography;[161] Professor Cosimo Bertacchi of Turin, who recently wrote a short paper on Armenia;[162] Professor Mario Baratta of Pavia, editor of the excellent educational journal *La Geografia*, who has recently added to his general studies of the "natural" eastern boundary of Italy in the Karst region[163] an investigation of the critical Adelsberg area.[164]

At the Accademia Scientifico-Letteraria of Milan geography is represented by Professor Giuseppe Ricchieri, who has long devoted himself to developing the methods of geography. During the war he published a paper on the geographical basis of Poland.[165] Associated with him as instructor is Paolo Revelli, who has recently written a paper on Italian influence in the development of political geography as a science[166] and a book on the relation of Italy to the Levant.[167]

## Recent Publications

The following topics of other recent publications will, like the work of the men just discussed, illustrate the high state of development of geography in Italy: the glacier-slip on the Italian side of Mont Blanc in November, 1920;[168] forests in relation to stream flow (based on H. M. Chittenden);[169] the historical development, content, and present tendencies of plant geography,[170] and the phytogeographical and zoögeographical position of the

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155 L'Italia e le sue regioni, 40 pp., Bologna, 1919.

156 L'uomo e le foreste, *Riv. Geogr. Ital.*, Vol. 25, 1918, pp. 141–180, 213–242, Vol. 26, 1919, pp. 47–57.

157 Geografia fisice e geologia, 244 pp., Milan, 1917.

158 Trattato di geografia fisica, 503 pp., Milan, 1902.

159 Sull' idrografia carsica dell' Altipiano dei Sette Comuni, *Ufficio Idrogr. Pubbl. No. 22*, Venice, 1911.

160 La distribuzione della popolazione in Sicilia e le sue variazoni negli ultimi quattro seculi, *Mem. Geogr. No. 36*, Florence, 1920.

161 La distribuzione delle popolazione nella Puglia centrale e meridionale secondo la natura del suolo, *Boll. Reale Soc. Geogr. Ital.*, Vol. 53, 1916, pp. 201–234, 274–305, 403–429; La distribuzione della popolazione in Puglia secondo la distanza dal mare, *ibid.*, Vol. 55, 1918, pp. 373–393, 597–622, 760–780; Zona di pioVosità e densità di popolazione nella proVincia di Lecce, *Riv. Geogr. Ital.*, Vol. 24, 1917, pp. 161–180.

162 L'Armenia: Una Polonia asiatica, *Quaderni Geogr. No. 2*, NoVara, 1918.

163 Confine orientale d'Italia, *Quaderni Geogr. No. 3*, NoVara, 1918, With two maps, 1 : 500,000 and 1 : 250,000.

164 La circolazione interna delle acque ed il confine orientale d'Italia, *La Geografia*, Vol. 8, 1920, pp. 124–145 (the region dealt With is shoWn on the 1 : 250,000 map of the publication listed in the preceding footnote).

165 Le basi geografiche della nazione polacca, *Boll. Soc. Geogr. Ital.*, Vol. 53, 1916, pp. 306–322 and 385–402.

166 Le origini italiane delle geografia politica, *Boll. Soc. Geogr. Ital.*, Vol. 55, 1918, pp. 118–129, 221–240, 394–416, 623–636, 728–759, Vol. 56, 1919, 230–243, 279–308, 395–422.

167 L'Italia e il mar di LeVante, 234 pp., Milan, 1917.

168 U. Valbusa: La catastrofe del Monte Bianco e del Ghiacciaio della Brenva, *Boll. Soc. Geogr. Ital.*, Vol. 58, 1921, pp. 95–114, 151–162, With photographs.

169 A. Scala: Influenza del bosco sul regime delle acque, *ibid.*, pp. 205–224.

170 A. Béguinot: La fitogeografia: SViluppo storico, contenuto, e direttiVe moderne, *La Geografia*, Vol. 6, 1918, pp. 322–346 and 435–465.

Adriatic region[171] (two papers of Professor Augusto Béguinot, botanist at the University of Padua); pastoral-agricultural life, *transhumance*, and provincial fairs in Piedmont;[172] the diminution of population in Basilicata;[173] mountains as language divides,[174] by Professor Francesco Musoni of the University of Padua; and the regional geography of Transcaucasia.[175]

In the field of cartography[176] mention should be made of a new advanced school atlas[177] published by the well-known Istituto Geografico De Agostini, under the editorship of its scientific director, Dr. Luigi Visintin, who studied under Brückner. A Brazilian edition of this atlas has also appeared. Achille Dardano of the Cartographic Office of the Ministry of Colonies has recently designed a symmetrical-elliptical projection for world economic maps.[178] A report on topographic mapping in Cyrenaica is of interest.[179]

## Spain [180]

At the Spanish universities the dualistic conception of geography may be said to prevail, "political and descriptive geography" being taught in the Faculty of Philosophy and Letters, and "cosmography and geophysics" in the Faculty of Science. The really essential part of the subject is that taught in the Faculty of Letters;[181] it here comes under the history section. The fact that the completion of studies in this section conferred upon the graduate (*licenciado*) the title of professor of history and geography in the secondary schools and that this led to overburdening the teacher and neglecting geography[182] brought about a movement for the separation of the

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[171] *Idem:* L'ipotesi dell' "Adria" nei rapporti con la corologia delle piante e degli animali, *ibid.*, Vol. 5, 1917, pp. 188–207.

[172] G. B. Roletto: Ricerche antropogeografiche sulla Val Pellice, *Mem. Geogr. No. 35*, Florence, 1918 (noticed in *Geogr. Rev.*, Vol. 7, 1919, pp. 265–266); La Valle dell' Orsigna: Appunti di geografia antropica ed economica, *Riv. Geogr. Ital.*, Vol. 23, 1916, pp. 432–440, Vol. 24, 1917, pp. 24–38; La transumanza in Piemonte, *ibid.*, Vol. 27, 1920, pp. 114–120, with map; La zona pastorale delle Valli di Lanzo, *La Geografia*, Vol. 9, 1921, pp. 1–25; Le condizione geografiche delle fiere di Pinerolo, *ibid.*, pp. 99–135.

[173] Paolo De Grazia: La diminuzione delle popolazione in Basilicata, *Boll. Soc. Geogr. Ital.*, Vol. 58, 1921, pp. 411–440 and 525–553.

[174] F. Musoni: Le linee di cresta dei sistemi montagnosi ed i confini delle aree etnico-linguistiche, *Riv. Geogr. Ital.*, Vol. 25, 1918, pp. 166–180.

[175] Silvio Govi: Transcaucasia, *L'Universo*, Vol. 1, 1920, pp. 295–319, Vol. 2, 1921, pp. 5–40, 81–120, with maps of the Caucasus region, mainly in 1 : 4,000,000, showing geology, relief, hypsometry, drainage, climate, precipitation, temperature, ethnography, types of cultivation, mineral resources, population density.

[176] See R. Almagià: La cartografia in Italia, *Riv. Geogr. Ital.*, Vol. 24, 1917, pp. 244–254.

[177] Atlante geografico metodico, 63 plates, Novara, 1921.

[178] Le proiezioni in planisfero per le carte di geografia economica, *La Geografia*, Vol. 7, 1919, pp. 24–41, with four world maps, 1 : 200,000,000, in Mollweide's, Aitoff's, Hammer's, and Dardano's projections.

[179] G. Gianni: I lavori topografici in Cirenaica, *L'Universo*, Vol. 1, 1920, pp. 387–406, with maps.

[180] On the recent development of geography in this country, see the last chapters in Becker's history of geography in Spain cited in footnote 188 and the relevant papers cited in the footnotes that follow. Among expressions of foreign thought exerting an influence on this development it is of interest to note W. S. Tower's paper on Scientific Geography in *Bull. Amer. Geogr. Soc.*, Vol. 42, 1910, pp. 801–825, which was translated in *Bol. Real. Soc. Geogr.*, Madrid, Vol. 53, 1911, pp. 129–169, by Vicente Vera, who, on Professor Beltrán y Rózpide's inability to come, was substituted as Spain's representative on the American Geographical Society's Transcontinental Excursion of 1912, but was likewise unable to attend (*Rev. de Geogr. Colon. y Mercantil*, publ. by Real Soc. Geogr., Madrid, Vol. 9, 1912, pp. 196–197 and 492–493).

[181] For this reason the universities at which only "cosmography and geophysics" are represented (Granada, Oviedo, Salamanca) are not shown on the accompanying map.

[182] Cf. G. M. Vergara: Las cátedras de geografía é historia de los institutos, *Rev. de Geogr. Colon. y Mercantil*, Vol. 8, 1911, pp. 121–123.

two subjects.[183] In 1914 geography and history were by royal decree established as separate subjects of study at the reorganized normal schools; likewise at the Instituto del Cardinal Cisneros of Madrid. In 1915, on the reorganization of the higher commercial studies, a professorship in geography was created at the Escuela Central de Intendentes Mercantiles in Madrid.

In this advancement of geography in Spain much is due to the activities of the Council of the Royal Geographical Society of Madrid, and particularly of its secretary-general, Don Ricardo Beltrán y Rózpide. His report to the Minister of Education in 1913 on the teaching of geography[184] is one of the important documents of the reform movement. Professor Beltrán y Rózpide is also professor of geography at the Escuela de Estudios Superiores del Magisterio in Madrid. Of his guide to the study of geography a new edition has recently appeared.[185] Among others who have contributed to modernizing geography in Spain are: Professor Odón de Buen, effective protagonist of our subject,[186] to whose efforts is due the creation in 1914 of the Instituto Español de Oceanografía in Madrid,[187] with maritime laboratories in the Balearic Islands and at Málaga and Santander; Jerónimo Becker of the Academy of History, author, among other fundamental works, of a comprehensive history of geography in Spain down to modern times;[188] Professor Eloy Bullon of the University of Madrid, who contributed a paper on the present state of geography in Spain;[189] A. Bartolomé y Más, professor of the industry and commerce of Spain at the aforementioned Escuela Central de Intendentes Mercantiles in Madrid, whose spirited introduction[190] to the book on economic geography of A. López Sánchez, professor of economic geography at the same institution, is a patriotic plea for the advancement of geography in his country's interest; and Antonio Blázquez, librarian of the Royal Geographical Society of Madrid, whose original volume on Spain[191] in his adaptation of Vidal de la Blache and Camena d'Almeida's textbook

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[183] Cf. the letter of March 3, 1911, from the Royal Geographical Society of Madrid to the Minister of Education, *Rev. de Geogr. Colon. y Mercantil*, Vol. 8, 1911, pp. 81–84.

[184] La geografía y su enseñanza, *ibid.*, Vol. 10, 1913, pp. 409–441. Second edition published as a 42-page pamphlet, Madrid, 1920.

[185] Geografía: Guía y plan para su estudio, con especial aplicación á la geografía económica, 3 vols.: Vol. 1, 264 pp., 3rd edition; Vol. 2, 291 pp., 2nd edition, both Madrid, 1920; Vol. 3, 1st edition, 196 pp., Madrid, 1917. (See synopsis, *Rev. de Geogr. Colon. y Mercantil*, Vol. 17, 1920, pp. 363–364, and review of first edition, *ibid.*, Vol. 14, 1917, pp. 41–52.)

[186] Cf. his inaugural address at the opening of the academic year 1909–10 at the University of Barcelona: La enseñanza de la geografía en España, *Bol. Real Soc. Geogr.*, Madrid, Vol. 51, 1909, pp. 409–441 (with references to previous papers of importance in the reform movement and a plea for the consideration of oceanography), and a paper read at the fortieth anniversary of the Madrid Geographical Society: La ciencia geográfica en España, *ibid.*, Vol. 58, 1916, pp. 143–153.

[187] Cf. Odón de Buen: El Instituto Español de Oceanografía y sus primeras campañas, *Trabajos de Oceanogr.* I, Madrid, 1916.

[188] Los estudios geográficos en España: Ensayo de una historia de la geografía, 366 pp., Real. Soc. Geogr., Madrid, 1917.

[189] Estado actual de la enseñanza de la geografía en España, *Bol. Real Soc. Geogr.*, Madrid, Vol. 58, 1916, pp. 153–170.

[190] Concepto y valor de la geografía y especialmente de la geografía económica, *Rev. de Geogr. Colon. y Mercantil*, Vol. 11, 1914, pp. 409–424.

[191] Antonio Blázquez, jointly with Delgado Aguilera: España y Portugal, Vol. 3 in Curso de Geografía por P. Vidal de la Blache, P. Camena d'Almeida y A. Blázquez adaptado á las necesidades de España y America (6 vols., Barcelona, 1913–16), Barcelona, 1914.

series on geography is one of the best modern geographies of that country.

The leading part played in the development of the modern scientific spirit in Spain by the Museo Nacional de Ciencias Naturales in Madrid under the jurisdiction of the Junta para Ampliación de Estudios é Investigaciones Científicas redounds to the benefit of geography. In the geological series of publications of the museum has appeared an excellent physical geography of the Iberian peninsula by Juan Dantín Cereceda,[192] thoroughly modern in method and spirit. Other numbers of geographical interest in the same series deal with the geology of the northern part of the peninsula, with the Quaternary glaciation of the mountains of Spain, and with the geography, including the human geography, of that important life-zone boundary, the Sierra de Guadarrama, at whose southern foot lies Madrid.[193] A product of the same school is a recent physiographic paper,[194] with block diagrams, on river capture in the Ronda basin in southern Spain. In the field of plant geography a recent book on the steppes of Spain[195] by Dr. Reyes y Prósper, professor of phytogeography at the University of Madrid, is of much interest. Among the numerous modern geographical works of Emilio H. del Villar there may be mentioned one on the subject-matter of geography and one on the "geographical value" of Spain.[196]

The recent military operations in Spanish Morocco have focused the country's attention on that region. Among timely publications may be mentioned a comprehensive history of European, especially Spanish, penetration in Morocco and a compilation of treaties and laws relating to that country by Jerónimo Becker,[197] a prize essay on the geographical, economic, and political aspects of Spanish Morocco,[198] an article by the Spanish Ambassador in London,[199] a study of the colonization problem,[200] contributions to the geology and physical geography,[201] and two maps.[202]

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[192] Juan Dantín Cereceda: Resumen fisiográfico de la Península Iberica, *Trabajos Museo Cienc. Nat. No. 9*, Madrid, 1912.

[193] E. Hernández-Pacheco: Ensayo de síntesis geológica del norte de la Península Iberica, *ibid.*, No. 7, 1912; Hugo Obermaier:—Picos de Europa,—Sierra de Gredos,—Sierra Nevada,—Sierra de Guadarrama, *ibid.*: *Serie Geol.*, Nos. 9, 14, 17, 19 (see note in *Geogr. Rev.*, Vol. 2, 1916, p. 308); C. Bernaldo de Quiros: Guadarrama, *ibid.*, No. 11, 1915, with bird's-eye view by Juan Carandell.

[194] Juan Carandell: Bosquejo geográfico del tajo de Ronda (Málaga), *Rev. de Geogr. Colon. y Mercantil*, Vol. 18, 1921, pp. 41–54.

[195] E. Reyes y Prósper: Las estepas de España y su vegetación, Madrid, 1915.

[196] La definición y divisiones de la geografía dentro de su concepto unitario actual, Barcelona, 1915; El valor geográfico de España: Ensayo de ecética, 301 pp., Madrid, 1921.

[197] Historia de Marruecos: Apuntes para la historia de la penetración europea y principalmente de la española en el Norte de Africa, Madrid, 1915; Tratados, convenios y acuerdos referentes á Marruecos y á la Guinea Española, Madrid, 1918.

[198] Abelardo Merino Álvarez: Marruecos, *Bol. Real. Soc. Geogr.*, Madrid, Vol. 63, 1921, pp. 5–168 (see *Geogr. Rev.*, Vol. 11, 1921, p. 618).

[199] Alfonso Merry del Val: The Spanish Zones in Morocco, *Geogr. Journ.*, Vol. 55, 1920, pp. 329–349 and 409–422 (transl. in *Bol. Real. Soc. Geogr.*, Madrid, Vol. 62, 1920, pp. 205–265, and noticed in *Geogr. Rev.*, Vol. 11, 1921, pp. 618–619).

[200] L. M. Peinador: El suelo de Marruecos y sus primeros habitantes: Problema hispano-marroquí, Madrid, 1920.

[201] Agustín Marin: Estudios relativos á la geología de Marruecos, *Bol. Inst. Geol. de España*, Vol. 42, Madrid, 1921; L. F. Navarro: Marruecos físico: Valor económico del protectorado español, *Rev. de Geogr. Colon. y Mercantil*, Vol. 18, 1921, pp. 221–239.

[202] Ecola y Mendez: España en Marruecos: Mapa de la zona en el norte del imperio asignada á España según el tratado de 1912, 1 : 450,000; and J. M. de Gamoneda: Mapa del Imperio de Marruecos, 1 : 600,000.

## Portugal

In Portugal the chief geographical centers are the University of Lisbon and the Geographical Society of Lisbon. At the university Professor F. Silva Telles is professor of geography. Professor Telles' views on the content of geography in relation to academic work have been expressed in several papers.[203] He is also professor of climatology at the School of Tropical Medecine in Lisbon.[204] Associated with Professor Telles at the university is Professor L. F. de Lencastre Schwalbach Lucci, who has done work along modern lines both in physical and human geography. One of his papers is a methodological study of a region from the geographical point of view.[205] Many of the activities of the Geographical Society of Lisbon are associated with the name of its secretary-general, Ernesto de Vasconcellos, who is also attached to the Colonial School in Lisbon. Professor Vasconcellos was a delegate to the recent disarmament conference in Washington, and the members of the Association of American Geographers had the pleasure of hearing him read a paper on the early Portuguese discoveries at their 1921 meeting in that city. Among Professor Vasconcellos' recent publications may be mentioned a paper on Portuguese geographical work since 1889[206] and a series of geographical monographs on the Portuguese colonies, of which the numbers on the Cape Verde Islands and Portuguese Guinea have appeared.[207] Of the special publications of the Lisbon society a volume containing papers on colonial and economic questions in preparation for post-war conditions[208] is of interest. Besides these institutions geography is also represented at the School of Commerce in Lisbon, at which Professor J. G. Pereira dos Santos gives courses in economic geography; at the University of Coimbra, where Professor A. F. Carvalho teaches both geography in the Faculty of Letters and geology in the Faculty of Science; and the University of Oporto, where Professor Mendes Corrêa's anthropological work has geographical bearing, particularly his recent book on race and nationality, with special reference to Portugal.[209] A work of outstanding merit, in some phases even taking on the aspect of a social philosophy without thereby digressing from its central theme, is Dr. D. G. Dalgado's book on the climate of Portugal.[210]

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[203] L'enseignement supérieur de la géographie, *Compte Rendu Trav. IX^e Congr. Internatl. de Géogr.*, Vol. 3, pp. 271–280, Geneva, 1911; and O conceito scientífico da geografia, *Rev. Univ. Coimbra*, Vol. 4, No. 1, 1915.

[204] This aspect of his work is reflected in: Le régionalisme climatologique, *Compte Rendu Trav. IX^e Congr. Internatl. de Géogr.*, Vol. 2, pp. 473–478, Geneva, 1910.

[205] Estudo metódico de uma região no ponto de vista geográfico, Lisbon. Other works: Estudos geográficos Alterações litorais; A ria de Aveiro), 70 pp., Lisbon, 1918; Emigração e colonização, 105 pp., Lisbon, 1914.

[206] Les voyages et les travaux géographiques des portugais depuis l'année 1889, *Atti del X Congr. Internaz. di Geogr.*, pp. 319–334, Rome, 1915.

[207] Colonias Portuguesas: Estudo elementar de geografia física, económica, e politica: I, Archipelago de Cabo Verde, Lisbon, 1916; II, Guiné Portuguesa, Lisbon, 1917.

[208] Questões coloniais e económicas: Conclusões e pareceres, 1913–1919, 339 pp., Lisbon, 1920.

[209] Raça e nacionalidade, 187 pp., Oporto, 1920.

[210] The Climate of Portugal and Notes on Its Health Resorts, 479 pp., Lisbon, 1914 (see notice in *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 787–788).

## Belgium [211]

In Belgium the development of geography at the universities may be said to be in a transitional stage, with the greater part of progress toward the modern conception of the subject accomplished, however. Geography is represented in some form at all four of the country's universities. At the University of Brussels it is closely associated with history, as it was at the French universities before the new development. It is not a degree subject in itself, but it is required for the doctorate in the "history group" in the Faculty of Philosophy and Letters.[212] It is there represented by Professors A. Hegenscheidt and C. Pergameni.[213] In the School of Political and Social Science a course is given by Professor M. Robert on the geography and anthropogeography of the Belgian Congo. To Professor M. Leriche, who gives courses in geology and physical geography in the Faculty of Science, we are indebted for a discussion of the natural regions of Belgium, exclusively on a geological basis, however.[214] Although not representing geography as such, Professor Jean Massart, the botanist, of the Faculty of Science, has, through his excursions,[215] and his phytogeographical work,[216] become one of the chief promoters of modern geography in Belgium. At the state universities of Ghent and Liége geography was put in a specially favorable position by being made, in 1900, a subject for the doctorate,[217] and, significantly enough, in the Faculty of Science. No special productivity in publication at Ghent from this development has come to the writer's notice. While Professor F. van Ortroy, the incumbent of the chair, has, in his reports to the *Geographisches Jahrbuch* from 1903 to 1912, on the progress of geography in Belgium, covered all branches of the subject, his own field of work has been mainly in political and historical geography.[218] The numbers of geographical interest in the *Recueil des Travaux Publiés par la Faculté de Philosophie et Lettres de l'Université de Gand* (No. 27, by Nees; No. 35, by Denucé; No. 44, by van Ortroy) all concern the history of geography.

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[211] For a history of the development of geographical thought in Belgium, see Jules Mees: Les sciences géographiques, pp. 225–272 of Vol. 1 of "Le mouvement scientifique en Belgique," 2 vols., Brussels, 1907.

[212] Université Libre de Bruxelles: Programme des Cours pour 1921–1922, 90 pp., Brussels, 1921; reference on p. 38.

[213] In 1913 Professor Pergameni began to give a course in the history of civilization. The following papers are an outgrowth of this work: La géographie de l'histoire: Causerie méthodologique, 22 pp., Brussels, 1913; Le milieu géographique et les principaux aspects de la civilisation japonaise, *Rev. Univ. de Bruxelles*, Vol. 26, 1920–21, pp. 185–200.

[214] Maurice Leriche: Les régions naturelles de la Belgique, *Rev. Univ. de Bruxelles*, Vol. 19, 1913–14, pp. 185–218. See also *Geogr. Rev.*, Vol. 11, 1921, pp. 583–585 (map, p. 584).

[215] Excursions scientifiques (géographie, géologie, botanique, zoologie) organisées par l'Extension de l'Université Libre de Bruxelles et dirigées par le professeur Jean Massart: I, Sur le littoral belge, *Rev. Univ. de Bruxelles*, Vol. 11, 1905–06, *passim;* II, Dans le Brabant, *ibid.*, Vols. 12, 13, 14, 1906–07, 1907–08, 1908–09, *passim;* III, Sur le bord de la Meuse, 220 pp., Brussels, 1911; IV, En Hollande, 119 pp., Brussels, 1912. Parts I (223 pp., Brussels, 1908) and II (356 pp., Brussels, 1913) have also appeared in book form.

[216] Main work: Esquisse de la géographie botanique de la Belgique (separate from *Recueil Inst. Bot. Léo Errera*, suppl. Vol. 7bis), 332 pp., with "annexe" containing photographs and maps, Brussels, 1910.

[217] Joseph Halkin: Le doctorat en géographie dans les universités belges, *Compte Rendu Trav. IX^e Congr. Internatl. de Géogr.*, Vol. 3, pp. 303–307, Geneva, 1911. Cf. also Note on the Position of Geography in Belgium, by a Belgian Professor, *Geogr. Teacher*, Vol. 10, 1919–20, p. 153.

[218] To his earlier works on the boundary treaties of Africa, Peter Apianus, and Mercator, he added, just before the war: L'œuvre cartographique de Gérard et de Corneille de Jode, *Recueil Trav. Fac. Philos. et Lettres Univ. de Gand No. 44*, Ghent, 1914.

However, at the University of Liége the new opportunity brought about a period of marked activity.[219] Under the direction of Professor Joseph Halkin, who studied for a time under Richthofen and Ratzel,[220] a modest but valuable series, *Travaux du Séminaire de Géographie de l'Université de Liége*, was begun in 1905 in which the doctor's theses and seminar papers appeared. The publication emerges from the war with renewed vitality, three numbers having been added in 1920 and 1921 to its ten pre-war issues. The titles of some of these papers betoken the modern spirit of the work being done at Liége.[221] At the Catholic University of Louvain the progressive quality of the work in geography is assured by its being in the hands of Professor P. Michotte, who has recently, basing his research on the most recent developments of the German school of thought no less than the French, published a penetrating analysis of the subject matter of geography.[222] A recent paper, product of the Louvain geography department, is also evidence of its progressive spirit.[223]

Under the auspices of the Comité National de Géographie, which was founded in 1920 and is subsidized by the Ministry of Science and Arts, the first Belgian interuniversity geographic excursion was held in September, 1921.[224] Inspired by the similar French excursions, which began in 1906, and modeled on the earlier Belgian ecological excursions conducted by Professor Massart, who also directed the present one, these excursions promise to become an important factor in the advancement of modern geography in Belgium.

## Elisée Reclus' Belgian Sojourn

It may be of interest here to make some mention of Elisée Reclus' Belgian sojourn, particularly as it bears some relation to the beginning of the modern movement in that country. Possibly in connection with certain endeavors to advance the status of geography,[225] and as a result of the greater freedom, within the combination with history, allotted geography in the higher institutions of learning by a law passed in 1890–1891, the great French geographer, who had just completed his monumental "Nouvelle Géographie Universelle," was in 1892 invited to give a course in geography at the University of Brussels. This appointment came to naught, however, seemingly because of his socialistic beliefs.[226] He soon became connected with the Université

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[219] Joseph Halkin: L'enseignement de la géographie à l'Université de Liége, *Trav. Sémin. de Géogr. Univ. de Liége No. 6*, Liége, 1907.

[220] From this period dates his: L'enseignement de la géographie en Allemagne et la réforme de l'enseignement géographique dans les universités belges, 171 pp., Brussels, 1900.

[221] No. 8, La rupture scandinave: Étude anthropogéographique; No. 9, La transhumance; No. 10, L'influence de la forêt sur l'homme; No. 11, Le coton au Congo belge; No. 13, La région des dunes en Belgique: Étude de géographie humaine.

[222] L'orientation nouvelle en géographie, *Bull. Soc. Royale Belge de Géogr.*, Vol. 45, 1921, pp. 5–43.

[223] Marguerite Lefèvre: Carte régionale du peuplement de la Belgique, *La Géogr.*, Vol. 36, 1921, pp. 1–34 (abstracted in *Geogr. Rev.*, Vol. 11, 1921, pp. 612–614).

[224] Program in *Bull. Soc. Royale Belge de Géogr.*, Vol. 44, 1920, pp. 254–256, and *Bull. Soc. Royale de Géogr. d'Anvers*, Vol. 41, 1921, pp. 154–157. Account in *Ann. de Géogr.*, Vol. 30, 1921, pp. 454–456; relevant maps and diagrams in *Bull. Soc. Royale Belge de Géogr.*, Vol. 45, 1921, pp. 44–59.

[225] Cf. the reform proposal in J. Du Fief: L'enseignement supérieur de la géographie en Belgique, *Bull. Soc. Royale Belge de Géogr.*, Vol. 16, 1892, pp. 225–249.

[226] Guillaume de Greef: Éloges d'Elisée Reclus et de Kellès-Krauz, Ghent, 1906, pp. 34–35; and obituary notice in *Ann. de Géogr.*, Vol. 14, 1905, p. 374.

Nouvelle of Brussels, an institution of university extension type, founded in 1891, at which he established, in 1898, an Institut Géographique.[227] This event proved of assistance to the movement for the advancement of geography, from which resulted, as outlined above, the introduction of the doctorate in geography at the state universities in 1900. The work of the institute was published in a series entitled *Publications de l'Institut Géographique de l'Université Nouvelle de Bruxelles*, of which seven numbers had appeared by 1902, one by Reclus himself.[228] To this period belongs the writing of his last work, "L'homme et la terre" (5 vols., Paris, 1905).

## The Netherlands

In the Netherlands the development of modern geography[229] has suffered from the fact that, when it was introduced at the universities, the unity of the subject was not recognized.

In 1907, when the veteran geographer, Professor C. M. Kan,[230] because of reaching the age limit retired from the chair he had occupied at Amsterdam University since 1877, two chairs were established, one in physical geography in the Faculty of Science, and the other in political geography and in the geography and ethnography of the Dutch East Indies in the Faculty of Letters and Philosophy. Likewise at the University of Utrecht, in 1907, the educational authorities proposed to establish a professorship in physical geography in the Faculty of Science and an instructorship in statistical, political, economic, and general geography in the Faculty of Letters. The plan further contemplated successively appointing professors of meteorology, climatology, oceanography, ethnology, etc. This brought forth protests from professional circles, and the instructorship in political geography was made a full professorship and the multifarious professorships were abandoned. However, to this day this dualistic conception of our subject persists at the Dutch universities. At Amsterdam E. Dubois, who recently contributed a paper on the historic function of dunes of Holland as natural dikes,[231] is professor of geology and physical geography, and S. R. Steinmetz of ethnography and social geography; at Utrecht the well-known geographers K. Oestreich, who was called from Germany to occupy the chair, and J. F. Niermeyer represent respectively geomorphology and economic geography.

This division of geography in the universities is of course detrimental to

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[227] Halkin, *Trav. Sémin. de Géogr. Univ. de Liége No. 6*, p. 15. Program in *Bull. Soc. Royale Belge de Géogr.*, Vol. 22, 1898, pp. 290–294.

[228] No. 5: L'enseignement de la géographie: Globes, disques globulaires et reliefs, Brussels, 1902.

[229] For a brief sketch of this development see the first part of H. Blink: De tragedie van het hooger onderwijs in de aardrijkskunde in Nederland, *Vragen van den Dag*, Vol. 34, 1919, pp. 801–814, Amsterdam. On geography in the universities see also W. E. Boerman: Hooger onderwijs in de aardrijkskunde en de opleiding van geografen, with postscript by H. Blink, *Tijdschr. Econ. Geogr.*, Vol. 10, 1919, pp. 157–160, and H. Blink: De handelsfaculteit aan de Amsterdamsche universiteit, in verband met de aardrijkskunde aan die faculteit, *ibid.*, pp. 331–337.

[230] Died in 1919. For a biographical notice with bibliography see J. A. C. A. Timmerman: Cornelius Marius Kan, *Tijdschr. Kon. Nederl. Aardrijksk. Genoot.*, Vol. 36, 1919, pp. 264–280.

[231] E. Dubois: Hollands duin als natuurlijke zeewering en de tijd, *ibid.*, Vol. 33, 1916, pp. 395–415.

the subject in the secondary schools,[232] as the great majority of prospective teachers get their training at the university. A movement to remedy these conditions is under way, and the Ministry of Education, Arts, and Sciences has recently addressed letters to the Councils of the Royal Netherlands Geographical Society, the Economic Geography Association, and other interested bodies, asking for expressions of opinion.[233] An improvement in conditions may be expected to result from these steps.

At the remaining two universities of the Netherlands, Leiden and Groningen, geography is only represented by a professorship in general history and political geography (J. Huizinga) at Leiden, and the ethnographic work of Professor A. W. Nieuwenhuis, of the same institution, mainly in New Guinea. At the School of Commerce (Handelshoogeschool) of Rotterdam, however, modern geography, mainly as economic geography, forms part of the curriculum. Professor J. F. Niermeyer comes from Utrecht to give courses. The subject is there also taught by Dr. H. Blink, who came into contact with the German school as a student of Gerland. Through his creation in 1910 of the monthly journal, *Tijdschrift voor Economische Geographie*, which owes a great measure of its value to his indefatigable pen,[234] he has done much to advance the cause of geography in the Netherlands. Recently the geographic staff at Rotterdam has been augmented by W. E. Boerman.[235] The work of Professor J. C. van Erde, who has recently published a helpful summary of the ethnography of the Dutch East Indies,[236] is also of interest to geographers. At the Polytechnic Institute (Technische Hoogeschool) of Delft the work of the geologists, particularly that of a general nature on the Dutch East Indies, is of geographical bearing. To Professor G. A. F. Molengraaf we owe a valuable summary of present knowledge of the structure of the East Indian Archipelago,[237] to which a paper on the present status of hydrographic surveys[238] is a helpful corollary. Professor H. A. Brouwer, who is at present exchange professor at the University of Michigan and who addressed the joint meeting of the Association of American Geographers and the American Geographical Society this spring, has recently published some results of his 1915 expedition to the Moluccas.[239] Of other work may be men-

[232] See for example P. Goedhart: Economische geographie en het onderwijs in aardrijkskunde, *Tijdschr. Econ. Geogr.*, Vol. 11, 1920, pp. 29–31.

[233] Letter from the Ministry, dated Feb. 24, 1920, and reply of Economic Geography Association in *Tijdschr. Econ. Geogr.*, Vol. 11, 1920, pp. 441–444. See also *Tijdschr. Kon. Nederl. Aardrijksk. Genoot.*, Vol. 38, 1921, pp. 313–314 and 462. For later developments, see *Tijdschr. Econ. Geogr.*, Vol. 12, 1921, pp. 112 and 188.

[234] Cf. in *Tijdschr. Econ. Geogr.* regional economic geographies of the Dutch provinces of Drenthe and Limburg (Vol. 10, 1919, Nos. 2–3 and 6–7) and foreign countries of economic interest, e.g. China and Japan (Vol. 12, 1921, No. 8–9; Vol. 13, 1922, No. 1). Cf. also interesting paper on economic regions: Regionale geographie, natuurlijke landschappen en economisch-geografische landschappen (Vol. 11, 1920, pp. 275–284).

[235] Cf. his inaugural address: Economische aardrijkskunde, *Tijdschr. Econ. Geogr.*, Vol. 11, 1920, pp. 411–420.

[236] Inleiding tot de volkenkunde van Nederlandsch-Indie, Haarlem, 1920.

[237] Modern Deep-Sea Research in the East Indian Archipelago, *Geogr. Journ.*, Vol. 57, 1921, pp. 95–121, with bathymetrical map, 1:10,000,000.

[238] C. Crandijk: Het werk der nederl. opnemingsvaartuigen in den Oost-Indischen Archipel, 1915–1920, *Tijdschr. Kon. Nederl. Aardrijksk. Genoot.*, Vol. 37, 1920, pp. 112–114, with map, 1 : 10,000,000. (One of a series of quinquennial summaries which have appeared in the *Tijdschr.* in 1904, 1910, 1915.)

[239] Geologische verkenningen in de oostlijke Molukken, *Verhand. Geol.-Mijnbouwk. Genoot. voor Nederland en Kolonien: Geol. Ser.*, Vol. 3, 1916, pp. 31–55; On the Tectonics of the Eastern Moluccas, *Proc. Royal Acad. Sci. Amsterdam*, Vol. 19, pp. 242–248, March, 1917.

tioned: in the field of human geography, a discussion of population centers in the Netherlands from the Roman period to 1920 by J. C. Ramaer,[240] two studies of the growth of a rural town into an industrial city,[241] and an illuminating discussion of East Friesland,[242] that northwesternmost corner of Germany, which is by its nature, history, and population so closely related to its Dutch counterpart; and, in the field of historical geography, the work of Dr. F. C. Wieder, known to us for his contribution[243] to I. N. Phelps Stokes's "The Iconography of Manhattan Island," on the Dutch aspect of the early exploration and cartography of Spitsbergen.[244] Among institutions that promote interchange of ideas, reference may also be made to the Geographische Kring,[245] or circle of geographers, and the geographical excursions,[246] the thirteenth of which was held in July, 1921, under the direction of Professor J. van Baren of the geological department of the Agricultural College of Wageningen.

## Switzerland

The universities of Switzerland of course reflect the essential bi-lingualism of the country. There are seven universities, but although the French-speaking inhabitants number about 20 per cent and the Germans 70 per cent of the whole population, each nationality may be said to maintain three and a half universities (Fribourg is bilingual). At all geography is represented. Each group draws its inspiration from, and belongs to the school of thought of, the country whose language it speaks. At the University of Fribourg Professor Paul Girardin, a pupil of Vidal de la Blache, in addition to doing physiographic work has written an excellent account of Fribourg as a study in city geography.[247] Like Luxemburg, in the principality of that name, which also deserves monographic treatment, Fribourg, with an upper town on the plateau top and a lower town in the valley bottom of the entrenched meanders of the river on which it lies, lends itself admirably to such a discussion. At the University of Lausanne Professor C. Biermann likewise does distinctive work in city geography, having written an excellent study of Lausanne[248] and its hinterland,[249] besides discussing Swiss cities

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[240] De middelpunten van bewoning in Nederland voorheen en thans, *Tijdschr. Kon. Nederl. Aardrijksk. Genoot.*, Vol. 38, 1921, pp. 1–38 and 174–215, with four maps showing status in 1795, 1840, 1880, and 1920.

[241] H. Blink: Eindhoven als economisch centrum, *Tijdschr. Econ. Geogr.*, Vol. 11, 1920, pp. 307–313; H. van Velthoven: De ligging en uitbreiding van Eindhoven, *Tijdschr. Kon. Nederl. Aardrijksk. Genoot.*, Vol. 38, 1921, pp. 397–399, with map, 1:20,000, showing growth since 1851.

[242] H. J. Moerman: Oostfriesland, *Tijdschr. Kon. Nederl. Aardrijksk. Genoot.*, Vol. 38, 1921, pp. 665–688.

[243] Cf. also his: Onderzoek naar de oudste kaarten van de omgeving van New York, *ibid.*, Vol. 35, 1918, pp. 235–260.

[244] F. C. Wieder: The Dutch Discovery and Mapping of Spitsbergen (1596–1829). Published by the Netherlands Ministry of Foreign Affairs and the Royal Dutch Geographical Society, Amsterdam, 1919.

[245] *Tijdschr. Kon. Nederl. Aardrijksk. Genoot.*, Vol. 36, 1919, pp. 217–219; Vol. 37, 1920, pp. 254–255; Vol. 38, 1921, pp. 313–314.

[246] Twelfth, *ibid.*, Vol. 36, 1919, pp. 551–558; Thirteenth, *ibid.*, Vol. 38, 1921, pp. 746–749.

[247] Fribourg et son site géographique: Étude de géographie urbaine, *Bull. Soc. Neuchâteloise de Géogr.*, Vol. 20, 1909–10, pp. 117–128.

[248] Situation et site de Lausanne: Études de géographie urbaine, *ibid.*, Vol. 25, 1916, pp. 122–149 (abstracted in *Geogr. Rev.*, Vol. 6, 1918, p. 285).

[249] Le Jorat, *ibid.*, Vol. 20, 1909–10, pp. 5–116.

in general.[250] He has also made a study of *transhumance* in Valais, the upper Rhone valley,[251] and of the geographical basis of civilizations.[252] Professor Maurice Lugeon, the well-known geologist of the Alps, is also a member of the faculty at Lausanne. His pupil, Professor Emile Argand of the University of Neuchâtel, has recently published a standard synthesis of our present knowledge of the structure of the Western Alps.[253] Swiss geography has sustained a great loss in the death of Professor Charles Knapp in August, 1921.[254] Professor Knapp occupied the chair of geography at the University of Neuchâtel. He was an indefatigable worker. He founded the Geographical Society of Neuchâtel and made its *Bulletin* a scientific force. He edited, with G. Michel, the series of maps entitled *Documents Cartographiques de Géographie Economique* in which many valuable maps appeared; likewise a monumental geographical dictionary of Switzerland.[255] At the University of Geneva physical geography is represented by Professor Emile Chaix; he is at present annually engaged in the study of the Swiss National Park in the Engadine, with his son Dr. André Chaix, who is instructor of geography at the university. Political geography is represented by Professor William Rosier.

At the University of Berne, where the department was created and organized by Professor Brückner, now of Vienna, Professor R. Zeller has recently replaced Dr. Hermann Walser, who died in 1919.[256] Among his contributions to local geography, which are characterized by much insight, may be mentioned a study of villages in the Swiss Foreland in the canton Berne.[257] He also wrote an explanation of the admirable wall map of Switzerland in 1 : 200,000 which was prepared under government auspices.[258] Dr. Fritz Nussbaum, instructor in geography at Berne, has worked in Swiss physiography[259] as well as human geography.[260] At the University of Basel Professor Hugo Hassinger, formerly of Vienna and editor of the recently discontinued Austrian journal, *Deutsche Rundschau für Geographie und Statistik*, occupies the chair of geography.[261] His work has dealt mainly with Austrian lands.[262] At the University of Zürich Dr. H. J. Wehrli is

[250] Géographie des villes suisses, *44e Annuaire Soc. Suisse de l'Enseignement Secondaire*, pp. 151–177.

[251] Le Valais, *Revue Alpine: Section Lyonnaise*, Vol. 14, 1908, pp. 261–285.

[252] Le cadre géographique des civilisations, *Atti del X Congr. Internaz. di Geogr. Roma 1913*, Rome, 1915, pp. 1047–1072.

[253] Sur l'arc des Alpes occidentales, *Eclogae Geologicae Helvetiae*, Vol. 14, No. 1, Lausanne, 1916.

[254] For biographical appreciations see *Bull. Soc. Neuchâteloise de Géogr.*, Vol. 30, 1921, pp. 5-12 (by C. Biermann), *Ann. de Géogr.*, Vol. 30, 1921, p. 466 (by C. Biermann), and *La Géogr.*, Vol. 36, 1921, pp. 435–436 (by P. Girardin).

[255] Dictionnaire géographique de la Suisse, 6 vols. and atlas, Neuchâtel, 1902–10 (there is also a German edition).

[256] For biographical notice see Rudolf Zeller: Hermann Walser, *Petermanns Mitt.*, Vol. 65, 1919, p. 65.

[257] Dörfer und Einzelhöfe zWischen Jura und Alpen, 46 pp., *Neujahrs-Blatt Litt. Gesell. Bern auf das Jahr 1901*, Berne, 1900.

[258] Die SchWeiz: Ein BegleitWort zur eidgenössischen SchulWandkarte, 3rd edit., Berne, about 1907 (French translation by C. Biermann, Berne, 1909).

[259] Die Täler der Schweizeralpen: Eine geographische Studie, 116 pp., Berne, 1910.

[260] Die Volksdichte des Kantons Bern, nebst Bemerkungen uber die Darstellung der Volksdichte in der SchWeiz, *Mitt. Naturforschenden Gesell. Bern*, 1919.

[261] Cf. his inaugural address: Über einige Aufgaben geographischer Forschung und Lehre, *Kartogr. und Schulgeogr. Zeitschr.*, Vol. 8, 1919, pp. 65–76, Vienna.

[262] E.g. Die mährische Pforte und ihre benachbarten Landschaften, 313 pp., map in 1 : 750,000, *Abhandl. Geogr. Gesell. Wien*, Vol. 11, No. 2, 1914; Bemerkungen über die Südostgrenze des deutschen Siedlungsgebietes, *Geogr. Zeitschr.*, Vol. 25, 1919, pp. 215–219.

professor of geography. He contributed the section on India and Farther India to Karl Andree's "Geographie des Welthandels."[263] Dr. A. de Quervain, known for his crossing of Greenland, is instructor in geography and meteorology. Mention should be made of Professor F. Becker, professor of cartography at the Zurich Polytechnic Institute, as representative of the Swiss school of cartography,[264] of whose plastic representation of relief by means of natural colors and shadows the firm of Kümmerly and Frey of Berne, publishers of the school wall map referred to above and many other maps, are possibly the best exponents. In the way of maps Switzerland has a valuable collection in the Musée Cartographique of Geneva, which contains, besides others, all the maps drawn for Elisée Reclus' "Nouvelle Géographie Universelle" by Charles Perron. An excellent relief model of Switzerland by Perron is in the foyer of the University of Geneva, and large-scale models of the Bernese Oberland and other mountain groups, as well as a series of maps illustrating the development of the cartography of the Alps, are in the Alpine Museum in Berne.[265]

## Austria

Austria, like German Switzerland, forms part of the German-speaking world of thought. With the universities political barriers have not counted: Germany, German Switzerland, and Austria have been a unit and their professorships have been interchangeable. Among geographers who have crossed the boundaries are Professor Penck of Berlin, long at Vienna (1885–1906); Professor Brückner of Vienna, who built up the department at Berne (1888–1904) and then went for a short time to Halle (1904–06); Professor Philippson of Bonn, who was for a short time in Berne (1904–06); Professor Friederichsen of Königsberg, who succeeded Professor Philippson at Berne for two years (1907–09); Professor Gustav Braun of Greifswald, who during part of the war was serving in the German army while professor at the Swiss University of Basel; and, among recent appointees, Professor Hassinger of Basel, who went there from Vienna, and Professor Krebs, who went from Vienna to Würzburg and then to his present chair at Freiburg. This relation to the German world, possibly more intimate since the cessation of Austria's orientation toward southeastern Europe, should obviously be borne in mind in any consideration of science in Austria.

Austria now has three universities, Vienna, Graz, and Innsbruck. At all geography is represented. At Vienna there are two professorships, occupied by Professor Eduard Brückner, author of the theory of climatic periodicity which bears his name and, with Penck, investigator of the glacial epoch in

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[263] Vorder- und Hinter-Indien, pp. 513–673 in "Karl Andrees Geographie des Welthandels," Vol. 2, Frankfort 1912.

[264] Some of the phases of its development, especially of topographic mapping, are sketched in F. Becker: Die schweizerische Kartographie im Jahre 1914 (Landesausstellung in Bern): Wesen und Aufgaben einer Landesaufnahme, 87 pp., *Schweiz. Zeitschr. fur Artillerie und Genie*, Frauenfeld, 1915.

[265] Cf. R. Zeller: Ein Rundgang durch das Schweizerische Alpine Museum in Bern, 36 pp., 3rd edit., Berne 1913.

the Alps, and by Professor Eugen Oberhummer, who has specialized in historical geography. Professor Oberhummer is president and Professor Brückner is one of the vice-presidents of the Vienna Geographical Society, which, through its contact with academic circles, has maintained a high standard. In November, 1916, the Society celebrated its sixtieth anniversary. On this occasion Professor Brückner discussed the Society's activities and the progress of geography in Austria during the preceding ten years.[266] Among his recent publications is a paper, partly based on the observations made during the American Geographical Society's Transcontinental Excursion of 1912, on the Great Lakes and their commercial importance.[267] Professor Oberhummer published in 1917 a valuable work on the racial origin and historical development of the Turks,[268] and another on the peoples of the Balkan Peninsula.[269] Recently, for the fourth centenary of Magellan's circumnavigation he wrote a critical account of the voyage, with maps of the route of the fleet through the Strait of Magellan and the East Indian archipelago.[270] Geography is further represented at Vienna by Dr. Erwin Hanslik and Dr. Otto Lehmann. Dr. Hanslik is known for his studies, important as to geographic method, of the contact between Slav and Teutonic civilizations, one of which deals with the German city of Biala in Galicia.[271] Dr. Lehmann specializes in physiography. Among his recent papers are a study of the Plateau of Langres,[272] the margin of the Paris Basin overlooking the Saône depression, observations for which were made on Professor Davis' excursion in France early in 1912, and a discussion of river sources.[273] Among other members of the Vienna faculty whose work has geographical bearing may be mentioned the ethnographer Professor Michael Haberlandt, who has recently published a book on the peoples of Europe and the Orient,[274] and Dr. Hans Mžik, who contributes a definition of the Orient.[275]

At Graz the chair of geography is occupied by Professor Robert Sieger, joint editor with Professor Franz Heiderich, of the School of World Commerce of Vienna, of the excellent re-creation of Karl Andree's "Geographie des Welthandels," to the final fourth volume of which he has contributed

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[266] Die k. k. Geogr. Gesellschaft und die EntWicklung der Geographie in Österreich in den letzten 10 Jahren. *Mitt. k. k. Geogr. Gesell. Wien*, Vol. 60, 1917, pp. 9–28.

[267] Die Grossen Seen Nordamerikas und ihre Bedeutung für den Verkehr, *ibid.*, Vol. 61, 1918, pp. 361–406.

[268] Die Türken und das Osmanische Reich, 115 pp., Leipzig, 1917 (someWhat expanded from original publication in *Geogr. Zeitschr.*, Vol. 22, 1916, pp. 65–87, 612–632, Vol. 23, 1917, pp. 78 ff. and 133 ff.).

[269] Die Balkanvölker, *Vorträge des Vereins zur Verbreitung naturwiss. Kenntnisse in Wien*, Vol. 57, 1917, pp. 263–332.

[270] Ferdinand Magellan und die Bedeutung der ersten Erdumsegelung, *Mitt. Geogr. Gesell. Wien*, Vol. 64, 1921, pp. 18–48.

[271] Biala, eine deutsche Stadt in Galizien: Geographische Untersuchung des Stadtproblems, 264 pp., Vienna, 1909.

[272] "Das Plateau von Langres" und die Hochfläche mit der Festung Langres, *Mitt. k. k. Geogr. Gesell. Wien*, Vol. 58, 1915, pp. 431–452.

[273] Über Fluss- und Bachursprünge in den Rückenlandschaften des feucht-gemässigten Klimas, *ibid.*, Vol. 61, 1918, pp. 113–142.

[274] Die Volker Europas und des Orients, 273 pp., Leipzig, 1920.

[275] Was ist Orient? Eine Untersuchung auf dem Gebiete der politischen Geographie, *Mitt. k. k. Geogr. Gesell. Wien*, Vol. 61, 1918, pp. 191–208.

a summarizing section on the classification of the economic regions of the world.[276] Recent of his writings in political geography deal with the relation between a state and its territory,[277] the state as an economic organism,[278] the geographical basis of the former Austria-Hungary,[279] and the broader geographical aspects of the difference in gauge of railway systems over the world and their influence on economic conditions.[280] Professor Heiderich has recently written on economic geography in general[281] and on the economic geography of Austria-Hungary.[282]

At Innsbruck Professor Johann Sölch occupies the chair of geography as successor to Professor Franz von Wieser, the eminent historian of cartography, who, at 70, had recently reached the retiring age at Austrian universities. Dr. Richard Marek, director of the Academy of Commerce in Innsbruck is also connected with the university. Professor Sölch contributed two papers to Professor Hettner's series on the war areas,[283] one on Rumania and one on Transylvania, and has recently published a geographical account of a pre-Alpine hill district between Mur and Drave on the German-Slovene contact zone.[284] Dr. Marek wrote a series of articles on the economic geography of southeastern Europe and Asia Minor and the commercial relations of these regions with Central Europe.[285]

The death of Professor Julius von Hann,[286] the eminent climatologist, in October, 1921, is a world loss to science. Only at the beginning of the year, at the age 83, did he turn over to younger hands the editorship of the *Meteorologische Zeitschrift*, which he had guided for fifty-five years.

## Austrian War Work in Geography

Like Germany, although on a smaller scale, Austria undertook the scientific investigation of the lands she occupied during the war. For the study of the portion of Russian Poland which was under Austrian administration—the section lying south of 51½° N., except for a strip along the

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[276] Die Wirtschaftsgeographische Einteilung der Erde, pp. 3–128 in Karl Andree's "Geographie des Welthandels," Vol. 4, Vienna, 1921.

[277] Staatsgebiet und Staatsgedanke, *Mitt. Geogr. Gesell. Wien*, Vol. 62, 1919, pp. 3–17.

[278] Die Nation als Wirtschaftskörper, in Festschrift Eduard Hahn zum 60. Geburtstag, Stuttgart, 1917.

[279] Die geographischen Grundlagen der österreichisch-ungarischen Monarchie und ihrer Aussenpolitik, *Geogr. Zeitschr.*, Vol. 21, 1915, pp. 1–22, 83–105, 121–131.

[280] Wegbahn und Spur, *Mitt. k. k. Geogr. Gesell. Wien*, Vol. 59, 1916, pp. 362–404, with map of the World in Eckert's projection, 1 : 90,000,000, showing gauges of railroad systems.

[281] Wirtschaftsgeographie, in Festschrift der k. k. Exportakademie, Vienna, 1917, abridged in *Mitt. k. k. Geogr. Gesell. Wien*, Vol. 60, 1917, pp. 223–228.

[282] Die weltpolitische und weltwirtschaftliche Zukunft von Österreich-Ungarn, *ibid.*, Vol. 59, 1916, pp. 73–105 and 137–169; Die Grundlagen der Agrarwirtschaft Österreichs, *ibid.*, pp. 727–735.

[283] Der siebenbürgische Kriegsschauplatz, *Geogr. Zeitschr.*, Vol. 23, 1917, p. 257 ff.; Der rumänische Kriegsschauplatz, *ibid.*, p. 409 ff.

[284] Die Windischen Bühel, *Mitt. Geogr. Gesell. Wien*, Vol. 62, 1919, pp. 220–226 and 241–276.

[285] Südost-Europa und Vorder Asien: Wirtschaftsleben und Handelsbeziehungen besonders mit dem Deutschen Reiche und der österreichisch-ungarischen Monarchie, *Geogr. Zeitschr.*, Vol. 22, 1916, pp. 139–161 (the lands on the lower Danube), 441–458 (former European Turkey and Montenegro), 510–527 (Greece), Vol. 23, 1917, p. 365 ff. and 422 ff. (Asiatic Turkey).

[286] Obituaries in *Meteorol. Zeitschr.*, Vol. 38, 1921, pp. 321–327; *Geogr. Rev.* (by R. DeC. Ward), Vol. 12, 1922, p. 312; *Ann. de Géogr.* (by Angot), Vol. 31, 1922, pp. 79–81; *Ann. Hydrogr. und Marit. Meteorol.*, Vol. 11, 1921, pp. 337–338.

Silesian border—[287]a Study Commission was created late in 1916 and attached to the Military Government of Lublin.[288] Its program was mainly directed to detailed studies in the natural sciences, and it therefore did not produce any synthetic geography of the area in its jurisdiction. Indeed this area is covered in the Handbook of Poland by the German commission already referred to. But the main Austrian field of work was the western Balkan Peninsula, especially Serbia, Montenegro, and Albania. Of most of this region adequate topographic maps were lacking, and the Austrian army engineers undertook its survey.[289] Before the war ended sheets in 1 : 50,000 had been completed of northern Serbia, western Montenegro, and central Albania. On the basis of this mapping Dr. Ernst Nowack, sometime of the School of Mines at Leoben, Styria, carried out various geological reconnaissances in 1917–18. In addition to the geology[290] and geomorphology,[291] which he discussed elsewhere, he has described the geography[292] of this region for readers of the *Review*. In the summer of 1916 Dr. Kerner von Marilaun of the Geologische Reichsanstalt had visited the little-known North Albanian Alps.[293] Under the auspices of the Vienna Geographical Society and the Academy of Sciences a geographical and geological expedition was sent to Serbia. Professor Krebs, then of Vienna, the geographer of the expedition, was in the field on two occasions of about five weeks in 1916, mainly in northern Serbia and the Novibazar region. He wrote several reports,[294] mainly on economic geography. An ethnographic expedition under the auspices of the Ministry of Education and the Academy of Sciences was undertaken in 1916 by Dr. Arthur Haberlandt, instructor in ethnography at the University of Vienna, in southern Serbia, Albania, and Montenegro.[295] In the summer of 1917 a general informational trip was organized by the Army Press Bureau to the occupied Balkan lands. Professor Oberhummer was a member of the party that went to Montenegro and Albania and has given us a geographical account of that trip.[296]

A consequence of the war, of special interest to geographers, may here be noted. Quite a number of the scientific staff of the Military Geographical Institute of Vienna, the excellent survey office of Austria, including the

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[287] Cf. J. G. Rothaug: Verwaltungsgebiete Österreich-Ungarns und des Deutschen Reichs in Polen, *Kartogr. und Schulgeogr. Zeitschr.*, Vol. 5, 1916, pp. 30–32, With map in 1 : 2,000,000.

[288] *Kartogr. und Schulgeogr. Zeitschr.*, Vol. 6, 1917, p. 56.

[289] Hubert Ginzl: Aufgaben und Tätigkeit der Kriegsmappierung auf der Balkanhalbinsel, *Mitt. k. k. Geogr. Gesell. Wien*, Vol. 61, 1918, pp. 497–513, With index map, 1 : 1,450,000, and samples of topographic sheets.

[290] Die geologische Erschliessung Albaniens im Kriege, *ibid.*, Vol. 62, 1919, pp. 211–219; Die Grundzüge der Tektonik Mittelalbaniens, *Centralblatt für Mineralogie*, 1920.

[291] Morphogenetische Studien aus Albanien, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1920, pp. 81–117.

[292] A Contribution to the Geography of Albania, *Geogr. Rev.*, Vol. 11, 1921, pp. 503–540.

[293] Reisseeindrücke aus den nordalbanischen Alpen, *Mitt. k. k. Geogr. Gesell. Wien*, Vol. 61, 1918, pp. 65–74.

[294] Vorläufiger Bericht über den ersten Teil der geographisch-geologischen Studienreise nach Serbien, *ibid.*, Vol. 59, 1916, pp. 609–614; —über den zweiten Teil —, *ibid.*, pp. 673–678; Wirtschaftsgeographische Beobachtungen auf den beiden Studienreisen nach Serbien, *ibid.*, Vol. 60, 1917, pp. 161–216, With statistical tables by Dr. Hermann Leiter; Zur Verkehrsgeographie Rasciens [i.e. the former sanjak of Novibazar], *Petermanns Mitt.*, Vol. 63, 1917, pp. 265–269.

[295] Berichte über die ethnographischen Arbeiten im Rahmen der historisch-ethnographischen Balkanexpedition, *Mitt. k. k. Geogr. Gesell. Wien*, Vol. 59, 1916, pp. 736–742.

[296] Montenegro und Albanien unter österreichisch-ungarischer Verwaltung, *ibid.*, Vol. 61, 1918, pp. 313–346,

chief of the technical division, Artur von Hübl, have been engaged by the Brazilian government for two years to co-ordinate the existing survey organizations in that country and establish a single organization to undertake the uniform topographic mapping of Brazil.[297] The Austrian cartographers reached Rio de Janeiro in October, 1920.

## Denmark

Geography in Denmark has suffered a serious loss by the death, in October, 1920, on his return from a trip to Canada and the United States, of Professor H. P. Steensby,[298] who occupied the chair of geography at the University of Copenhagen since 1911. An all-round modern geographer in all that that term implies, he had developed the geography department at Copenhagen, the only one in Denmark, to a high state of efficiency. Fortunately he has left us an outline of his views in a book entitled "Introduction to the Study of Geography at the University of Copenhagen,"[299] which would prove a valuable guide to the student of geography in any country. In it he discusses such topics as the method of geography and the solution of geographical problems and gives a history of the growth of the various branches of the science and an outline of the development of geography as a university subject. He concludes with a systematic survey of landforms and their modifying agencies, including a characterization of the humid, glacial, and arid cycles of erosion. With Professor Steensby's work on Eskimo culture geography[300] and on the early Norse voyages to America[301] readers of the *Review* are already familiar.

As successor to Professor Steensby Dr. Martin Vahl was appointed in August, 1921. Professor Vahl's work has been mainly in plant geography: he collaborated with Warming in the preparation of his well-known manual of ecology and some years ago investigated the question of life zones from the phytogeographical standpoint.[302] He has recently published a generalized map of the vegetation regions of South America based on climate.[303]

Of other recent results of geographical work in Denmark may be mentioned a comprehensive geographical handbook of Denmark[304] by numerous authors under the editorship of Daniel Bruun, historian of the early Norse

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[297] Einrichtung eines militärgeographischen Instituts in Brasilien durch österreichische Militärgeographen, *Kartogr. und Schulgeogr. Zeitschr.*, Vol. 9, 1921, p. 16.

[298] See obituary notices in *Geografisk Tidskrift*, Vol. 25, 1919–20, pp. 262–263, and *Meddelelser om Grønland*, Vol. 37, pp. i–ii, 1921.

[299] Inledning til det geografiske Studium ved Københavns Universitet, 190 pp., Copenhagen, 1920.

[300] An Anthropogeographical Study of the Origin of the Eskimo Culture, *Meddelelser om Grønland*, Vol. 53, pp. 39–228, 1917 (cf. Clark Wissler in *Geogr. Rev.*, Vol. 9, 1920, pp. 125–138).

[301] Norsemen's Route from Greenland to Wineland, *Meddelelser om Grønland*, Vol. 56, pp. 149–202, 1917; also reprinted as separate book, 109 pp., Copenhagen, 1918.

[302] Zones et biochores géographiques, *Overysigt Kong. Danske Vidensk. Selsk. Forhdl.*, 1911, No. 5 (= pp. 269–317).

[303] Vegetationskort over Sydamerika, *Geografisk Tidskrift*, Vol. 25, 1919–20, pp. 197–204, with map in 1 : 60,000,000.

[304] Danmark: Land og Folk: Historisk-topografisk-statistisk Haandbog. Edited by Daniel Bruun with the collaboration of a number of specialists. 2 Vols. (Vol. 1, 663 pp.; Vol. 2, 429 pp.), Copenhagen, 1919. (Professor Steensby's contribution, "Danmarks Natur," is noticed in the *Geogr. Rev.*, Vol. 12, 1922, p. 327.)

settlement in Greenland under Eric the Red;[305] a new edition of a German translation[306] of Warming's manual of ecology; and an anthropogeographical study of Farther India.[307] In the pre-eminently Norse field of Arctic geography, an invaluable summary of the geography of Greenland,[308] with atlas, has just appeared in the *Meddelelser om Grønland*, in commemoration of the bi-centenary of the landing of Hans Egede, the "apostle of Greenland," and Knud Rasmussen has given us a general account of the results of his Second Thule Expedition in 1916–18,[309] while outlining the plans for his fifth expedition.[310] Lauge Koch, geologist of the Rasmussen expeditions, in a recent paper[311] suggests structural continuity between the ancient Caledonian mountain system (Scotland and Norway) and western Spitsbergen, northern Greenland, and northeastern Ellesmere Island. The career of the veteran geographer of Iceland, Thorvald Thoroddsen, who died in September, 1921,[312] was closed with the publication of an account of his island home and its people,[313] a Danish version of the Icelandic original.

## Norway

The foremost advances in geography in Norway center, of course, around the name of Nansen. In his scientific capacity Dr. Nansen is professor of oceanography at the University of Christiania. Among his recent publications are a paper and book on his cruise to Spitsbergen in 1912[314] from whose results he makes deductions as to the tidal wave in the North Polar Basin and the extension and shape of the basin, and a preliminary but fundamental study (with Professor Helland-Hansen of the Bergen Geophysical Institute) of the temperature variation in the North Atlantic Ocean and in the atmosphere as a basis for the investigation of the cause of climatological variations.[315]

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[305] Erik den Røde og Nordbokolonierne i Grønland, Copenhagen, 1915 (reVieWed in *Geogr. Rev.*, Vol. 5, 1918, p. 254.)

[306] Eugen Warming's Lehrbuch der ökologischen Pflanzengeographie, von E. Warming and P. Graebner, 2nd edition, Berlin, 1918.

[307] Johannes Reumert: Nogle Traek af Bagindiens Anthropogeografi, *Geografisk Tidskrift*, Vol. 26, 1921–22, pp. 89–98 and 120–124.

[308] Grønland i Tohundredaaret for Hans Egedes Landing. 2 Vols. and atlas (*Meddelelser om Grønland*, Vols. 60 and 61 and atlas), Copenhagen, 1921. The text contains a 174-page general account of Greenland, followed by detailed accounts of the various districts. The atlas contains general maps in 1 : 10,000,000 and detailed in 1 : 1,000,000. An English edition of the Work in 3 Vols. is in preparation.

[309] Grønland langs Polhavet: Udforskningen af Grønland fra Melvillebugten til Kap Morris Jesup, Copenhagen, 1919. English edition: Greenland by the Polar Sea: The Story of the Thule Expedition from Melville Bay to Cape Morris Jesup, New York, no date [1922?], With map of new surveys in northern Greenland 1 : 2,500,000.

[310] Den V. Thule-Ekspedition: Den danske Ekspedition til arktisk Nordamerika under Ledelse af Knud Rasmussen, *Geografisk Tidskrift*, Vol. 26, 1921–22, pp. 57–60.

[311] Stratigraphy of NorthWest Greenland, *Meddelelser fra Dansk Geol. Forening*, Vol. 5, No. 17, map p. 73 text p. 75.

[312] See obituary notices in *Geografisk Tidskrift*, Vol. 26, 1921–22, p. 100, and this number of the *Geogr. Rev.*

[313] Island: Land og Folk, translated from the 3rd edition of the Icelandic original, Copenhagen, 1919.

[314] Spitsbergen Waters: Oceanographic ObserVations during the Cruise of the "Veslemöy" to Spitsbergen in 1912, *Kristiania Videnskapsselskapets Skrifter: I, Mat.-Naturv. Klasse*, 1915, No. 2, 132 pp. (reViewed in *Geogr. Rev.*, Vol. 3, 1917, pp. 500–501); En ferd til Spitsbergen, Christiania, 1920.

[315] Temperatur-SchWankungen des Nordatlantischen Ozeans und in der Atmosphäre: Einleitende Studien über die Ursachen der klimatologischen SchWankungen, *ibid.*, 1916, No. 9, Viii and 341 pp. Translated into English, With additions by the authors and by Dr. C. G. Abbot, the solar phYsicist, as *Smithsonian Misc. Colls.*, Vol. 70, No. 4, Viii and 408 pp., 1920.

Geography at the university is further represented by two instructorships, one in physical geography, occupied by W. Werenskiold, known for his work on the physiography of Norway,[316] the other in political geography, held by A. Arstal. Professor H. Mohn, who was working up the meteorological results of Amundsen's Antarctic expedition,[317] as of his previous expeditions, died in 1916.[318] Amundsen himself spent the winter of 1921–22 in the United States, completing, with Dr. H. U. Sverdrup, at the Carnegie Institution of Washington, the preparation of the studies in terrestrial magnetism to be made on his proposed drift across the Polar Basin in the *Maud*. Of the first part of this trip he has recently published an account.[319] Among other publications of interest may be mentioned a map, in more detail than is usual, of Nicholas II Land and adjacent islands north of Cape Chelyuskin, Siberia;[320] a report on the surveys made in 1909–10 by Gunnar Isachsen in Spitsbergen;[321] an article on the Lapp reindeer herds in Norway and their seasonal migration partly within Norway and partly across the Norwegian-Swedish frontier;[322] a geographical study of Christiania by Dr. Hans Reusch,[323] director of the Geological Survey of Norway, and an important atlas of the economic geography of Norway.[324]

## Sweden

Modern geography is in a high state of development in Sweden. A rapid advance has taken place in the last few years, for which an active group of younger men is in no small measure responsible. The older established centers, however, are active also. The Swedish Anthropological and Geographical Society of Stockholm in 1919 added to its valuable organ *Ymer*, in which articles of general interest appear in Swedish, a scientific quarterly of international scope called *Geografiska Annaler*, in which papers are published mainly in English, French, and German. Its maintenance is guaranteed for at least five years by a gift of 100,000 crowns which was made to the society for that purpose. In addition there are geographical associations, of a more professional type and centering around the staff of

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[316] Cf. e.g. The Surface of Central Norway, Memorial Vol. Transcontinental Excursion of 1912 of the Amer. Geogr. Soc., New York, 1915, pp. 357–365.

[317] *Kristiania Videnskapsselskapets Skrifter: I, Mat.-Naturv. Klasse*, 1915, No. 5 (reviewed in *Geogr. Rev.*, Vol. 2, 1916, p. 484, and Vol. 6, 1918, pp. 524–525), and 1916, No. 3.

[318] See obituary notices in *Monthly Weather Rev.*, Vol. 44, 1916, p. 518, and *Norske Geogr. Selskabs Aarbok*, Vol. 26–27, 1914–16, pp. vi–ix.

[319] Nord-Ost Passagen, Copenhagen, 1921.

[320] *Norske Geogr. Selskabs Aarbok*, Vol. 26–27, 1914–16, opp. p. 28, mean scale, 1 : 4,000,000.

[321] Gunnar Isachsen: Travaux topographiques de l'Expédition Isachsen, 1909–10. *Kristiania Videnskapsselskapets Skrifter: I, Mat.-Naturv. Klasse*, 1915, No. 7, 63 pp., with map 1 : 200,000 (referred to on pp. 216–218 in Charles Rabot: The Norwegians in Spitsbergen, *Geogr. Rev.*, Vol. 8, 1919, pp. 209–226, an article which is brought down to date by M. Rabot's note in the *Geogr. Rev.*, Vol. 12, 1922, pp. 303–304).

[322] Kristian Nissen: Lapper og ren i Norge, *Norske Geogr. Selskabs Aarbok*, Vol. 26–27, 1914–16, pp. 45–110, with map, 1 : 2,000,000.

[323] Kristiania geografi, 52 pp., Christiania, 1913, with two maps in 1 : 30,000 and 1 : 10,000.

[324] Per Nissen: Ökonomisk-geografisk atlas over Norge med en oversigt over de kulturelle og ökonomiske forhold saerlig naeringsveiene. Utarbeidet med statsbidrag under medvirken av mange fagmaend. (Atlas of the economic geography of Norway with a survey of the cultural and economic relations especially to trade. Compiled with government support and with the collaboration of many specialists.) 66 pp. text and 48 pp. maps, Christiania, 1921.

the geographical departments, at the three university towns of Gothenburg, Upsala, and Lund. The association at Gothenburg issues a journal at irregular intervals;[325] the Geografiska Föreningen in Lund was founded in February, 1921.

At the University of Stockholm human geography is highly developed. It is there in the hands of Dr. Sten De Geer, son of Baron De Geer, the well-known geologist. Concentrating on the fundamental problem of population distribution, he studied the island of Gothland[326] and the cities of the Baltic Sea region[327] and then brought his work to culmination in an admirable atlas of the population distribution of Sweden,[328] in which the "dot" and "sphere" methods of representation[329] tried out in the previous investigations were effectively applied. Other publications of Dr. De Geer deal with suggested new administrative subdivisions of Scandinavia on a geographic basis[330] and the political geography of the New Europe.[331] At the School of Commerce in Stockholm Professor Gunnar Andersson, editor of the geographical society's publications and, until recently, its secretary-general, is professor of economic geography. In this field, to which he turned from his earlier work in plant geography, he has recently devoted his attention to Australia[332] and the food resources of the world.[333]

At the University of Lund geography is strongly represented. In the Faculty of Letters Professor Helge Nelson, devoting himself at first to intensive studies of the history of settlement in the mining district of central Sweden,[334] has recently published an excellent paper on the human regions of Sweden,[335] in which human agglomerations are the basis of subdivision, in recognition of the fact that they are outgrowths of the region in which they lie and expressions of its character. The paper is intended to

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[325] *Meddelanden från Geografiska Föreningen i Göteborg*, No. 1, 1912; No. 2, 1917.

[326] Befolkningens fördelning på Gottland, *Ymer*, Vol. 28, 1908, pp. 240–253, with maps in 1 : 300,000 and 1 : 900,000.

[327] Storstäderna vid Östersjön, *ibid.*, Vol. 32, 1912, pp. 40–87, with plate of maps of Baltic cities in 1 : 100,000 showing built-up area generalized. Cf. also *idem*: Die Grossstädte an der Ostsee, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1912, pp. 754–766.

[328] Karta över befolkningens fördelning i Sverige den 1 januari 1917. Atlas of 12 plates in 1 : 500,000 accompanied by separate explanatory text: Befolkningens fördelning i Sverige: Beskrivning till karta i skalan 1 : 500,000, 296 pp., Stockholm, 1919. (See note in *Geogr. Rev.*, Vol. 9, 1920, p. 360, and Dr. De Geer's own statement in the *Geogr. Rev.* referred to at the end of the next footnote.)

[329] On the method of representation see Per Stolpe: Till frågan om Gottlands befolkningsfördelning, *Ymer*, Vol. 28, 1908, pp. 413–419; reply by Sten De Geer, *ibid.*, pp. 451–452; Alfred Söderlund: Förslag till intensitetsbeteckning vid konstruktion av täthetskartor, *ibid.*, Vol. 35, 1915, pp. 267–272; G. A. Larsson: Intensitetsbeteckningar vid kartografisk framställning av befolkningsfördelningen i tätare bebyggda trakter, *ibid.*, pp. 351–364; Sten De Geer: A Map of the Distribution of Population in Sweden: Method of Preparation and General Results, *Geogr. Rev.*, Vol. 12, 1922, pp. 72–83.

[330] Sveriges landsdelar, *ibid.*, Vol. 38, 1918, pp. 24–48 (abstracted in *Geogr. Rev.*, Vol. 11, 1921, pp. 143–144).

[331] Europas statsgränser och statsområden efter världskriget, *ibid.*, Vol. 40, 1920, pp. 253–302, with map showing the foreign population elements within the countries of Europe as now constituted.

[332] Om sambandet mellan natur och kultur i Australien, *Ymer*, Vol. 34, 1914, pp. 293–330; Australien: Natur och kultur, Stockholm, 1915 (reviewed in *Geogr. Rev.*, Vol. 7, 1919, pp. 431–432).

[333] Vårt dagliga bröd: Näringsväxterna i världsproduktionen, Stockholm, 1916.

[334] Om kulturgeografien i skolan (examples: Öland and Västra Västmanlands bergslag), *Ymer*, Vol. 32, 1912, pp. 88–102; En bergslagsbygd, *ibid.*, Vol. 33, 1913, pp. 278–352.

[335] Geografiska studier över de svenska städernas och stadslika orternas läge, *Lunds Univ. Årsskrift*, N. S., Section I, Vol. 14, No. 13, 110 pp., 1918; Sveriges kulturgeografiska provinser: Ett bidrag till diskussionen om Sveriges landsdelar, *Ymer*, Vol. 38, 1918, pp. 341–354 (noticed, with map, in *Geogr. Rev.*, Vol. 11, 1921, pp. 144–145).

furnish the foundation for a later detailed study of Swedish cities.* Professor Nelson was in the United States and in Canada last summer, studying settlement methods in the northern Great Plains area. Dr. John Frödin of the Faculty of Science has dealt with the glacial features[336] and the tree limit[337] in northern Lapland and, lately, with *transhumance* in an alpine grazing region in central Sweden near the Norwegian border.[338] In the past summer he was engaged in a phytogeographical expedition to Morocco.[339] Dr. Arnold Norlind of the Faculty of Letters has studied the question of climate in historic times, especially in northern and central Europe,[340] and, recently, Magellan's circumnavigation of 1521.[341]

At the University of Gothenburg the chair of geography is occupied by the well-known geographer, Professor Otto Nordenskjöld. He has recently published a concise and helpful history of the development of scientific geography during the nineteenth century[342] and has added to his previous regional geography[343] a general geography[344] of the Polar lands. Professor Nordenskjöld has recently returned from a trip to Chile and Peru.[345] Oceanography is represented by Dr. Hans Pettersson, who has recently been investigating the relationship between meteorological influences and internal movements in stratified coastal waters.[346]

At the University of Upsala physical geography predominates. Dr. H. W. Ahlmann, until 1921 at the University of Stockholm, is doing advanced work in physiography according to modern methods. In keeping with his earlier expressed conception of geomorphology,[347] and its application to lake shores,[348] he recently published an excellent physiographic study of Norway.[349] He followed this with a preliminary investigation of the geomorphology of southern Sweden,[350] where conditions are more obscure than in the neighboring Norwegian area, the study of which in a way served as preparation. Dr. Ahlmann has also successfully worked in economic

[336] Några iakttagelser rörande glaciationen i norra delen af Lule Lappmark, *Ymer*, Vol. 35, 1915, pp. 98–109.

[337] Studier öVer skogsgränserna i norra delen av Lule Lappmark, *Lunds Univ. Årsskrift*, N. S., Section II, Vol. 13, No. 2, 1916 (With German résumé).

[338] Fäbodbebyggelsen i Kall och Offerdal, *Geografiska Annaler*, Vol. 1, 1919, pp. 353–386.

[339] *Ymer*, Vol. 41, 1921, pp. 356–358.

[340] Till frågan om det historiska klimatet, särskilt i Nord- och Mellaneuropa, *ibid.*, Vol. 35, 1915, pp. 83–97.

[341] Fernão de Magalhães och den forsta världsomseglingen 1519–22: Till 400-årsminnet, *Ymer*, Vol. 41, 1921, pp. 1–24.

[342] Geografisk Forskning og geografiske Opdagelser i det nittende Aarhundrede (in series: The Nineteenth Century Described by Scandinavian Scientists, edited by Aage Friis), Copenhagen, 1920 (Swedish edition, Stockholm, 1921), reVieWed in *Geogr. Rev.*, Vol. 12, 1922, p. 324.

[343] Polarvärlden och dess grannländer, Stockholm, 1907 (German edition, Leipzig, 1909; French edition Paris, 1913.)

[344] Polarnaturen (in series: Popular Scientific Lectures at the UniVersity of Gothenburg), Stockholm, 1918. reVieWed in *Geogr. Rev.*, Vol. 12, 1922, p. 324.

[345] En resa i Sydamerikas Kordillerastater, *Ymer*, Vol. 41, 1921, pp. 227–253.

[346] Papers in *Meddel. Geogr. Fören. i Goteborg*, No. 2, 1917, pp. 29–44, and *Geografiska Annaler*, Vol. 2, 1920, pp. 33–66, and Vol. 3, 1921, pp. 165–182.

[347] Geomorfologin som modern vetenskap, *Ymer*, Vol. 35, 1915, pp. 67–82.

[348] Strandzonens allmänna morfologiska utveckling med särskild hänsyn till insjöar, *Ymer*, Vol. 34, 1914, pp. 241–270.

[349] Geomorphological Studies in NorWay, *Geografiska Annaler*, Vol. 1, 1919, pp. 1–148 and 193–252 (reVieWed by W. M. DaVis in *Geogr. Rev.*, Vol. 9, 1920, pp. 368–369).

[350] Some Working Hypotheses As Regards the Geomorphology of South Sweden, *Geografiska Annaler*, Vol. 2, 1920, pp. 131–145.

geography, recently producing a thoroughgoing study of northern Sweden.[351] The work done by the other members of the department of geography (Professor Axel Hamberg, head of the department, and Dr. F. Enquist) relates mainly to the glacial geology of Sweden. Professor Rudolf Kjellén of the political science department, however, makes contributions to human geography.[352]

Among other work of interest may be mentioned J. G. Andersson's investigations in China,[353] where he has been engaged since 1914 as adviser to the Chinese Government in mining matters, and his association with the recently created Geological Survey of China;[354] Baron Gerard De Geer's work in glacial and post-glacial geochronology, in connection with which he visited the United States and Canada in 1920,[355] and his recently published studies on Spitsbergen;[356] and Professor Carl Skottsberg's expedition to the eastern Pacific islands.[357] Among noteworthy publications the first volumes published of Sven Hedin's elaborate work on Southern Tibet,[358] with a map of Central Asia and Tibet in 1 : 1,000,000, stands foremost.

## Finland

In keeping with the general high cultural level of Finland, geography has long been in an advanced state of development in that country, and even greater progress may be expected as a result of the newly acquired political independence. For over thirty years—since 1888—two geographical societies have existed in Helsingfors,[359] the Sällskapet för Finlands Geografi (Société de Géographie de Finlande) and the Geografiska Föreningen i Finland (Société Finlandaise de Géographie). The former, devoting itself almost exclusively to the geography of Finland, has since 1889 issued a valuable journal, *Fennia*, in which its researches are published, with sum-

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[351] The Economical Geography of Swedish Norrland, *Geografiska Annaler*, Vol. 3, 1921, pp. 97–164 (abstracted in the *Geogr. Rev.*, Vol. 12, 1922, pp. 132–133).

[352] Inledning till Sveriges geografi, Gothenburg; Die Grossmächte der Gegenwart, Leipzig, about 1915 (German translation; post-war adaptation as: Die Grossmächte und die Weltkrise, Leipzig, 1920).

[353] Professor J. G. Andersson's forskningar i Kina, *Ymer*, Vol. 39, 1919, pp. 157–173 (see also notice in *Geografiska Annaler*, Vol. 1, 1919, pp. 387–388).

[354] J. G. Andersson: The National Geological Survey of China, *Geografiska Annaler*, Vol. 3, 1921, pp. 305–310.

[355] See note in *Geogr. Rev.*, Vol. 11, 1921, p. 139.

[356] On the Physiographical Evolution of Spitsbergen, Explaining the Present Attitude of the Coal-Horizons, *Geografiska Annaler*, Vol. 1, 1919, pp. 161–192, with map, 1 : 500,000 (reviewed in *Geogr. Rev.*, Vol. 8, 1919, pp. 283–285); Om Spetsbergens natur i Sveagruvans omnejd, *Ymer*, Vol. 39, 1919, pp. 240–277, with map, 1 : 100,000.

[357] Till Robinson-ön och världens ända, Stockholm, 1918 (reviewed in *Geogr. Rev.*, Vol. 12, 1922, pp. 324–325). See also *idem*: The Islands of Juan Fernandez, *Geogr. Rev.*, Vol. 5, 1918, pp. 362–383.

[358] Southern Tibet: Discoveries in Former Times Compared With My Own Researches in 1906–1908, 9 vols. (Vols. 1, 2, 3, 5 so far published, Stockholm, 1916–17), atlas of Tibetan panoramas (Stockholm, 1917), and separate maps: route surveys, 1906–08, 26 sheets in 1 : 300,000 (12 published, 1917); 40 sheets in 1 : 200,000; map of Central Asia and Tibet, 1 : 1,000,000 in 15 sheets (two published, 1917). (See a discussion of the historico-geographical, cartographical, and geomorphological phases of the work in *Ymer*, Vol. 38, 1918, pp. 101–186, and review in *Geogr. Rev.*, Vol. 10, 1920, pp. 424–425).

[359] Cf. e.g. Exposé des travaux géographiques executés en Finlande jusqu'en 1895: Communication faite au 6ème Congrès International de Géographie à Londres, 1895, par la Société de Géographie de Finlande, Helsingfors, 1895, pp. 7–8.

maries in German, French, or English. The latter has taken all of geography as its field and has published two journals, the one, since 1888, *Geografiska Föreningens Tidskrift* (called *Terra* since 1913), with articles of general interest in Swedish and Finnish only, and the other, since 1892, *Meddelanden af Geografiska Föreningen*, with major contributions in the two national languages but with German, French, or English résumés. In 1921 both societies were amalgamated,[360] retaining the name and journal of the former. It is not known whether the journals of the latter have ceased publication.

The work of the Geografiska Föreningen centers about the names R. Hult and J. E. Rosberg and is thereby closely associated with the development of geography at the University of Helsingfors.[361] About at the time of the founding of the two societies an instructorship in geography was established at the university and Dr. Hult was called to occupy it. He organized a department of geography in 1890 and through his work in the university became one of the leading contributors to the renascence of geography in Finland and to its recognition as a science. One aspect of Dr. Hult's work is familiar to American geographers because of the fact that Professor Ward has repeatedly called attention to his subdivision of the earth into climatic provinces.[362] Dr. Hult died in 1899. In 1902 the instructorship was raised to an associate professorship, and later to a full professorship, and Professor J. E. Rosberg, the present incumbent, was called to the chair. From that day to this[363] he has been an active worker in the improvement of geography in the schools, and was one of the chief memorialists of the petition to the government on that question.[364] In 1907 the position of director of seminar work in the department was created and Dr. J. G. Granö, well-known for his physiographic work in Mongolia and the Altai, the latest results of which have recently appeared,[365] was appointed. In 1908 an instructorship was established and Dr. I. Leiviskä, the present incumbent, appointed. He has recently published a comprehensive study, based on ten years' work, of the Salpausselkä,[366] the great terminal moraine which forms the southern border of the Finnish lake district.

At Åbo a university (Academy) with Swedish as the official language was opened in 1919, but only geology (H. G. Backlund), not geography is represented. Whether geography forms part of the curriculum of the

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[360] Index Generalis: Annuaire général des universités, etc., 2nd issue, Paris, 1921, p. 1344.

[361] See L'enseignement de la géographie en Finlande: Exposé sommaire présenté par la Société Finlandaise de Géographie, *Meddel. Geogr. Fören. i Finland*, Vol. 8, 1907–09, 10th article, sections on the university, pp. 14–19, and on the Société Finlandaise de Géographie, pp. 19–21.

[362] Jordens klimatområden: Försök till en indelning of jordytan efter klimatiska grunder, *Meddel. Geogr. Fören. i Finland*, Vol. 1, 1892–93, pp. 140–201, with map of World in Mollweide's projection, 1 : 150,000,000. See Ward in *Bull. Amer. Geogr. Soc.*, Vol. 38, 1906, pp. 472–474, with Hult's map in Mercator's projection, equatorial scale, 1 : 97,000,000; and *ibid.*, Vol. 46, 1914, p. 110.

[363] Geografin och dess studium i Finland, särskilt Åbo, *Åbo Akad. Årsskrift*, 1918.

[364] Geografiska Föreningen inlaga till K. Senaten i geografi frågan, *Geogr. Fören. Tidskrift*, Vol. 18, 1906, pp. 161–166.

[365] Les formes du relief dans l'Altai russe et leur genèse: Étude morphologique, *Fennia*, Vol. 40, No. 2, 128 pp. (reVieWed in the *Geogr. Rev.*, Vol. 11, 1921, pp. 155–156).

[366] Der Salpausselkä (in German), *Fennia*, Vol. 41, No. 3, 388 pp., 1920, With map 1 : 400,000.

Finnish-language university which was to be opened also at Åbo in 1921 is not known.

The Sällskapet för Finlands Geografi, not content with having produced an atlas of all phases of the geography of Finland (second edition, 1911), the like of which, for their national domain, only three or four countries in the world can boast, has, as one of the first scientific obligations of political independence, undertaken the preparation of a systematic geography of the country.[367] The work, which is in preparation by a number of specialists under the editorship of Dr. R. Witting, the Society's secretary, will consist of two volumes of about 700 pages each, the first dealing with nature and the second with man. The work will first appear in Swedish and Finnish, but an edition in one of the "world languages" is contemplated. Being causal in its geographical treatment it will not duplicate the handbook recently published under the auspices of the Ministry of Foreign Affairs.[368] A recent publication of the Society's on Finland's boundaries,[369] including those of the new outlet to the Arctic Ocean established by the Treaty of Dorpat of October 14, 1920, is of interest.

Of other interesting work may be mentioned that done in Finland to correlate with Baron De Geer's studies of the glacial and post-glacial time scale[370] and papers on the type landscapes and natural regions,[371] the phyto-geographical boundaries[372] and the cities[373] of Finland, and a work on Eastern Carelia and Lapland.[374]

## The Baltic States

Each of the three Baltic States has a university, Lithuania at Kovno (founded in 1920), Latvia at Riga (1919), and Esthonia at Dorpat (re-organized 1919). The records available do not show whether geography is part of the curriculum at Kovno or Riga. At Dorpat, the Finnish geographer, Dr. J. G. Granö, referred to above as director of seminar work in the department of geography at the University of Helsingfors, is listed as full professor of geography.

## Poland

The new state of Poland has five universities: Warsaw, Cracow, Lwów (Lemberg), Lublin, and Poznań (Posen). Poznań and the Catholic University of Lublin are new foundations since the war. At all the universities except Lublin geography is represented. At Warsaw, according to recent

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[367] Aperçu des actes de la Société d'octobre 1915 à mai 1918, *Fennia*, Vol. 40, No. 1, pp. 98–106, 1919; reference on pp. 105–106, detailed synopsis of contents in preceding report in Swedish, pp. 19–36.

[368] Finnland im Anfang des XX. Jahrhunderts, Helsingfors, 1919.

[369] Les frontières de Finlande, *Fennia*, Vol. 42, No. 10, 1921, with map 1 : 2,000,000.

[370] Matti Sauramo: Geochronologische Studien über die spätglaziale Zeit in Südfinnland, *Fennia*, Vol. 41 No. 1, 44 pp., 1918.

[371] J. E. Rosberg: Finska landskapstyper, *Fennia*, Vol. 40, No. 9, 25 pp., 1919.

[372] Om växtgeografiska gränslinjer i Finland, *Meddel. Geogr. Foren. i Finland*, Vol. 10, 1913–14, first article.

[373] J. Qvist: Die Städtebildung in Finnland und ihre geographischen Voraussetzungen, *ibid.*, seventh article.

[374] Theodor Homén, edit.: Ostkarelen och Kola Lappmark skildrade av finska natur- och språkforskare, Helsingfors, 1920 (English edition, London, 1921).

information,[375] there would seem to be two universities, the old university of Warsaw, and a recently founded Free University of Poland. At the former plant geography (B. Hryniewiecki) and meteorology (W. Gorczyński) are represented. At the latter there are professorships of physical geography and geography of Poland (S. Lencewicz), economic geography (J. Loth), meteorology (W. Smosarski), and ethnography (S. Poniatowski). At the University of Cracow the well-known physiographer, L. Sawicki, is professor of geography. At Poznań the chair of geography is occupied by S. Pawlowski, who recently published a geography of Poland.[376] Most of these instructors are contributors to the excellent first volume of the *Révue Polonaise de Géographie* (*Przeglad Geograficzny*) edited by Professor Sawicki and published by the recently (1917) founded Polish Geographical Society (Polskie Towarzystwo Geograficzne) in Warsaw. The review will only appear more or less irregularly at present, but each volume will be followed by a separate annual bibliography covering the geographical literature on Poland and geographic publications in Polish. An important predecessor of the Polish Geographical Society was the Polish Society for Geography (Polskie Towarzystwo Krajoznawcze),[377] which was founded in Warsaw about in 1906. In 1910 it began the publication of a weekly periodical called *Ziemia* (*Earth*), which, however, stopped at the beginning of the war. This society numbered 850 members in Warsaw by 1909 and several hundred more in the 21 sections it maintained in other parts of Poland. Since 1914 it has co-operated in the publication of the important series of *Physiographic Memoirs* (*Pamiętnik Fizyograficzny*) which have been appearing since 1881 and contain many important contributions to the geography of Poland.

Pre-eminent among Polish geographers is Professor Eugeniusz Romer of the University of Lwów, widely known for his studies of the human and political geography of Poland during the war and at the peace conference. His most important work is the admirable Atlas of Poland[378] (Warsaw, 1916; second edition, 1921), recently supplemented by an "Atlas des Problèmes Territoriaux de la Pologne" (Lwów, 1921), which reproduces many of the maps prepared for the Paris and Riga peace conferences, among the latter one in 1 : 1,050,000 (Pl. 39) showing the eastern boundary of Poland according to the Treaty of Riga, signed March 17, 1921. Under the editorship of Professor Romer a series of geographical memoirs is appearing (*Travaux Géographiques Publiés sous la direction de E. Romer*) of which some five numbers have been issued, dealing mainly with Polish problems of political geography. Associated with Professor Romer at Lwów are

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[375] Index Generalis for 1921, pp. 454 and 456.

[376] Geografia Polski, Lwów, 1917. See also list of Pawlowski's papers in *La Géogr.*, Vol. 36, 1921, p. 107.

[377] M. Friederichsen: Die Polnische Gesellschaft für Landeskunde in Warschau: Aus Anlass ihres zehnjährigen Bestehens, *Petermanns Mitt.*, Vol. 62, 1916, pp. 459–460; *idem*, *Geogr. Jahrbuch*, Vol. 38, 1915–18, pp. 332–333; L. Sawicki: Landeskundliche Bestrebungen in Polen, *Kartogr. und Schulgeogr. Zeitschr.*, Vol. 6, 1917, pp. 53–56 (this article contains a good general survey of the status of geography in Poland).

[378] Cf. review (by R. H. Lord) in *Geogr. Rev.*, Vol. 11, 1921, pp. 308–309; also *Ann. de Géogr.*, Vol. 29, 1920, pp. 382–384.

J. Czekanowski as professor of ethnology and H. Arctowski, well-known for his work on climatic changes and long resident in the United States, as professor of geophysics.[379]

Of great importance is a monumental Polish Encyclopedia undertaken by the Academy of Sciences in Cracow. Nineteen sections were contemplated, the first half of which are of geographical interest. Fortunately several of the first volumes have already been published:[380] Vol. 1 in 1912 on "The Physical Geography of the Polish Lands and Physical Characteristics of the Population" consisting of 16 articles by different contributors; Vols. 2 and 3 in 1915 on the Polish language and Vol. 4 on the beginnings of Slavonic civilization. Other sections were to deal with political history, historical geography, statistics, and economic conditions. Another work of this type, though originally intended for propaganda, is the Encyclopédie Polonaise published by the Comité National Polonais en Amérique.[381] Reference has already been made to the publications of the German geographical commission in Poland (p. 446).

## Czechoslovakia

Since the establishment of Czechoslovakia as an independent state, two new universities have been founded, at Bratislava (Pressburg) and Brno (Brünn), but neither of them includes all the faculties as yet, and geography is not on the curriculum. At Prague, however, it is. Here, as before the war, there are two separate universities, the Czech and the German. At both geography is represented. At the Czech university there are two professorships of geography, occupied by V. Švambera, known for his work on the Congo, and J. V. Daneš, who has made a study of karst phenomena in various parts of the world, notably in Bosnia and Queensland. There are assistant professorships in meteorology and climatology (S. Hanzlík) and in economic and human geography (V. Dvorsky) and instructorships in geomorphology (V. Dědina) and ethnography (K. Chotek). At the German university the veteran African explorer Oskar Lenz is emeritus professor of geography, and Fritz Machatschek professor of geography. Dr. Machatschek, who is known for his physiographic work, has recently published in Penck's series of regional monographs the final results of his investigations in Turkestan,[382] to which the outbreak of the war abruptly put an end. Symptomatic of the change of conditions are the comparative pre-war and present budgets (in crowns) of the department of geography at the two universities, as follows: 1913 Czech, 1000; German, 1000; 1921: Czech, 6000; German, 1000.

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[379] See his Agriculture and Landownership in Poland, *Geogr. Rev.*, Vol. 11, 1921, pp. 161–171.

[380] See *Ann. de Géogr. Bibliogr. Géogr. Annuelle* for 1913–14, No. 409, and H. Praesent: Bibliographischer Leitfaden für Polen, *Beitr. zur Polnischen Landeskunde*, Reihe B, No. 2, Berlin, 1917, pp. 4, 36–37, 38, 95–96.

[381] To embrace six volumes. Among the volumes of geographical interest already published are: Vol. 2 (Part I: Géographie et ethnographie; Part II: Démographie générale; Part III: Développement territorial), with atlas, Lausanne, 1920 (Part IV: Émigration et colonies polonaises à l'étranger, in press); Vol. 3 (Vie économique de la Pologne), with atlas, Lausanne, 1919.

[382] Landeskunde von Russisch-Turkestan (in series: Bibliothek länderkundlicher Handbücher, herausgegeben von A. Penck), 348 pp., Stuttgart, 1921.

Another factor in the development of geography in Czechoslovakia is the flourishing Czech Geographical Society at Prague, founded in 1895, which since its establishment has been publishing a valuable periodical (*Sborník České Společnosti Zeměvědné*) containing articles on Bohemia and systematic lists of geographical publications in Czech. Intellectual contact with France is maintained by the Institut Français de Prague, at which Professor Alfred Fichelle gives courses, mainly on the geography of France.[383]

## Hungary

Since the war Hungary is reduced to two universities, the ancient University of Budapest and the newly founded (1914) University of Debreczen. At Budapest in addition there was established in 1919 a "Faculty of Political Economy." In 1907 a university had been created at Pozsony, but when this city became part of Czechoslovakia, the Hungarian university was withdrawn. A Czechoslovak university was established under the new name of the city, Bratislava, but, as stated above, geography is not represented in its curriculum. The faculties at Pozsony, likewise at Kolozsvár, now become Rumanian (see the section below), were transferred intact to Budapest. At all the Hungarian institutions referred to—Budapest, university as well as Faculty of Political Economy; Debreczen; Pozsony; Kolozsvár—geography is represented. The continued existence, at Budapest, of the Universities of Pozsony and Kolozsvár—according to the Hungarian conception—would seem to be indicated by the issuance under date of 1921 of the valuable first number of a joint publication of the geographical institutes of those two universities and of the university of Budapest and the Faculty of Political Economy.[384]

At the University of Budapest the chair of geography, formerly occupied by Professor Géza Czirbusz, who has recently published the first three volumes of a four-volume treatise on human geography[385] and a paper on the historical development of Budapest,[386] seems at present unoccupied, but there are instructorships in branches of geography, among which may be mentioned that of Dr. Michael Haltenberger in regional physiography. Dr. Haltenberger pursued studies in the United States in 1913, mainly relating to Block Island, on which he published several papers,[387] both before and after his return to Hungary. While here, he also wrote an interesting paper on

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[383] A reflection of his reciprocal function, the spreading of knowledge of Czechoslovakia in France, is his paper: Les débouchés maritimes de la Tchécoslovaquie, *Ann. de Géogr.*, Vol. 30, 1921, pp. 241–248.

[384] Francis Fodor: Conditions of Production in Hungary, *Hungarian Geogr. Essays (Joint Publ. of the Geogr. Insts. Univ. of Budapest, Fac. of Polit. Econ., Univ. of Kolozsvár, and Univ. of Pozsony) No. 1*, 10 pp., diagrs. and maps, Budapest, 1921.

[385] Human Geography: Part I, Influence of Landforms, 127 pp., Budapest, 1915; Part II, Anthropogeography, 104 pp., Budapest, 1917; Part III, Political Geography, 62 pp. Budapest, 1919 (all in Hungarian). Part IV will deal with historical geography. Cf. the reviews in *Petermanns Mitt.*, Vol. 63, 1917, p. 37, and Vol. 64, 1918, p. 235.

[386] Historisch-geographische Lage von Budapest, *Kartogr. und Schulgeogr. Zeitschr.*, Vol. 7, 1918, pp. 81–86 With map, 1 : 100,000.

[387] Among them: A Study of the Cartographical Development of Block Island, R. I., 36 pp.; Physical Geography of Block Island, R. I., 43 pp.; both Hungarian Adriatic Assoc., Budapest, 1917.

primitive modes of transportation.[388] During the war he discussed Rumania.[389] On the Faculty of Political Economy geography is represented by the well-known geographer, Count Paul Teleki, who occupies the chair of economic geography. Count Teleki was head of the Hungarian commission of preparation for the peace conference and later first Minister of Foreign Affairs and then Premier of Hungary. Count Teleki was indefatigable in working out material bearing on the geography, especially the ethnography of Hungary for the peace conference. The following are some of the publications of which he was the author or editor: four series of maps of Hungary in 1 : 200,000[390] showing (1) nationality, (2) religious adherence, (3) ability or inability to speak Hungarian, (4) ability or inability to read and write, which because of their large scale and the consequent placing of the colored circles, of size proportional to the number of inhabitants, in the actual locations where people live, give an intimate picture of conditions; a general ethnographic map of Hungary[391] on which, by an ingenious method, the area shown as inhabited by each nationality is proportional to its numbers; and a paper[392] and a valuable atlas[393] on the economic geography of Hungary. Among relevant publications by others may here be mentioned an atlas[394] and a general survey[395] of Hungary, historical, ethnographic, and economic. Count Teleki revisited the United States in 1921, on which occasion he addressed the Institute of Politics at Williams College.

At the University of Debreczen Dr. R. Milleker, author of a treatise on vulcanism[396] and formerly joint editor of the international edition of the *Bulletin of the Hungarian Geographical Society*, is professor of geography. At Pozsony Dr. Gyula Prinz had been appointed to the chair of geography; he had from personal association studied the structure and ethnography of the Tian Shan.[397] At Kolozsvár the head of the department was the well-known geographer, Professor Jenö de Cholnoky, now president of the Hungarian Geographical Society. Among his numerous publications only one, a general paper on the Great Hungarian Lowland,[398] which reflects

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[388] Primitive Carriers in Land Transportation, *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 729–745.

[389] Rumänien in politisch-geographischer Beleuchtung, *Kartogr. und Schulgeogr. Zeitschr.*, Vol. 6, 1917, pp. 138–142.

[390] Ethnographical Map of Hungary, 1 : 200,000, 53 sheets (8 not finished) in portfolio, Hungarian Geogr. Soc., Budapest, 1918. Similarly: The Communes of Hungary Showing (2) The Distribution of Religions; (3) The Persons Speaking Hungarian; (4) The Persons Able to Read and Write. Data on all maps are hand-colored.

[391] Paul Teleki: Ethnographical Map of Hungary Based on Density of Population, 4 pp. of text and map in 1 : 1,000,000, [Budapest, 1918].

[392] Paul Teleki: Short Notes on the Economical and Political Geography of Hungary, 15 pp. and 6 maps mainly in 1 : 4,000,000.

[393] Paul Teleki, A. de Edvi Illés, and A. Halász, edits.: The Economics of Hungary in Maps, 6th revised edition with 75 maps and 6 diagrams, Budapest, 1921. The various elements represented are shown for all of Hungary in its former as compared with its present extent on maps in 1 : 4,000,000.

[394] La Hongrie: Cartes et notions géographiques, historiques, ethnographiques, économiques, et intellectuelles, 48 pp., [Budapest, no date].

[395] Louis Lóczy, edit.: A Geographical, Economic, and Social Survey of Hungary, 122 pp., Budapest, 1919.

[396] A vulkanizmus teoriái, Szegedin, 1910.

[397] Reise in den südlichen Gebirgsketten des Tien-Schan zwischen Narin und Maral-Baschi, *Bull. Hungarian Geogr. Soc.: Internatl. Edit.*, Vol. 38, 1910, pp. 185–211; Ethnographische Beobachtungen im Tien-Schan, *A Magy. Nemz. Múzeum Néprajzi Osztályának Értesítöje*, Vol. 9, No. 1–2, pp. 69–90, Budapest, about 1909.

[398] Die Oberflächengestalt des Alföld, *Bull. Hungarian Geogr. Soc.: Internatl. Edit.*, Vol. 38, 1910, pp. 275–297, with physiographic map, 1 : 1,200,000, showing natural limits of the Alföld.

his work as head of the Alföld Commission of the geographical society, can be mentioned. The head of one of the Society's other commissions, that on Lake Balaton and editor of its many-volume scientific results, the eminent geologist, Professor Lajos Lóczy, died in 1920.

## Rumania

The war has practically made no interruption in the existing energetic development of geography in Rumania; indeed, this development has proceeded more rapidly since that time. In this growth the Royal Rumanian Geographical Society of Bukharest has been an important factor. The important influence exerted as a matter of course by the universities has been enhanced since their increase, after Rumania's territorial enlargement, from the former two, Bukharest and Jassy, to four by the addition of Cluj (Kolozsvár) and Cernăutsi (Czernowitz).

The university men active in this development have been trained both in Germany and in France. Professor Mehedintsi, head of the department of geography at the University of Bukharest, is a pupil of Ratzel, under whom he took his Doctor's degree in 1899 with a suggestive thesis[399] and to whose memorial volume he contributed an anthropogeographical paper on the Rumanian steppe.[400] To provide a medium of expression for the work done in his department he created in 1909 an annual publication entitled *Anuar de Geografie shi Antropogeografie*, which has at least appeared to 1915 and which is replete with valuable studies in the geography, more especially the human geography, of Rumania.[401] Professor N. Iorga, the well-known historian at the University of Bukharest and editor of the *Bulletin de l'Institut pour l'Etude de l'Europe Sud-Orientale*, also makes contributions to geography, mainly on Rumanian territorial development.[402]

At the University of Cluj, in the department formerly presided over by the well-known Hungarian geographer Professor Cholnoky, Dr. G. Vâlsan has recently been appointed professor of geography. Professor Vâlsan is a pupil of Professor De Martonne of Paris. His thesis,[403] published in 1915, is an important and extensive physiographic study of the Rumanian plain. Both before and after this work he has made important contributions, mainly physiographic, to modern geographical knowledge of Rumania.[404] Associated with Professor Vâlsan at Cluj is Professor V. Merutsiu, who directed the department alone before Professor Vâlsan came from Jassy.

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[399] Kartographische Induktion, Diss. Univ. Leipzig, 1899.

[400] Die rumänische Steppe: Eine anthropogeographische Skizze, "Zu Friedrich Ratzels Gedächtnis," Leipzig, 1904, pp. 249–255.

[401] For list of contents of Vol. 1, 1909–10, and Vol. 2, 1910–11, see: *Ann. de Géogr. Bibliogr. Géogr. Annuelle*, 1911, p. 170; of Vol. 3, 1913, *Bul. Soc. Reg. Române de Geogr.*, Vol. 34, 1913, No. 1, pp. 233–234; of Vol. for 1914–15, *ibid.*, Vol. 36, 1915, pp. 773–774.

[402] Auf- und Niedergang des türkischen Herrschaftsgebietes in Europa, *Petermanns Mitt.*, Vol. 59, I, 1913, pp. 1–7, with 5 maps, 1 : 10,000,000; Die Entwicklung des rumänischen Staatswesens, *ibid.*, Vol. 61, 1915, pp. 260–263, with ethnographic map, 1 : 1,500,000, by Langhans.

[403] Câmpia Română, *Bul. Soc. Reg. Române de Geogr.*, Vol. 36, 1915, pp. 313–568, with French résumé.

[404] Asupra trecerii Dunărei prin Portile de Fier: Studie de geografie critică, *ibid.*, Vol. 37, 1916–18, pp. 133–152; Văile: Origina shi evolutsia lor, *ibid.*, pp. 333–353; La terre et le peuple roumains, *Rev. Gén. des Sciences*, Vol. 31, 1920, pp. 338–342.

Professor Merutsiu has written papers on the salt deposits of Rumania[405] and the Rumanians of Transylvania.[406] The work of the department at Cluj has recently been described by Professor Vâlsan[407] and by Professor De Martonne,[408] the latter having given courses there and conducted an excursion in Rumania during the summer of 1921.

At the University of Jassy Dr. M. D. David is interim professor of geography. He recently published a paper on the physiographic evolution of Moldavia between the Sereth and the Pruth.[409] Professor I. Simionescu, the geologist at that institution, does work of geographical bearing, recently publishing a series of views, with comment, of Rumanian landform types.[410] At the University of Czernowitz, where Supan taught in the early days of his career, geography is at present represented by Professor K. A. Penecke, who occupied the chair of geology under the Austrian régime and still gives courses in geology. Dr. I. Prelipcean is listed as director of the geographical institute, likewise of the mineralogical institute.

Among other men of modern training should be mentioned Dr. Alexander Dimitrescu, who unfortunately died in 1917 at the age of 36.[411] He finished his studies in Germany, acquiring the doctorate in 1911 at the University of Berlin with a thesis on the lower Danube.[412] At Berlin he became familiar with American physiographic methods during Professor Davis' visiting professorship at that university. In addition to papers which reflect this influence on his studies,[413] he wrote on Rumania as a transit land.[414]

Among war-problem publications of geographical interest may be mentioned a map in 1 : 1,000,000 showing the distribution of Rumanians,[415] a political, historical, and ethnographic atlas of Rumania,[416] several publications on the Dobrudja,[417] and a reprint of Premier Bratianu's presentation of Rumania's territorial claims at the peace conference.[418]

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[405] Sarea în pământul Românese, *Bul. Soc. Reg. Române de Geogr.*, Vol. 33, 1912, pp. 69–162.

[406] Românii între Tisa shi Carpatsi: Raporturi etnografice, *Riv. Shtiintsifică V. Adamachi*, Vol. 6, 1915, pp. 135–143, Jassy.

[407] *Bul. Soc. Reg. Române de Geogr.*, Vol. 38, 1919, pp. 329–331.

[408] E. de Martonne: Enseignement et excursions géographiques en Roumanie, *Ann. de Géogr.*, Vol. 31, 1922, pp. 64–66.

[409] O schitsa morfologică podishului Sarmatic din Moldova, *Bul. Soc. Reg. Române de Geogr.*, Vol. 39, 1920, pp. 331–381, with French résumé.

[410] Tipuri geografice din România, *ibid.*, Vol. 36, 1915, pp. 714–738, with 64 illustrations (first published in *Rev. Shtiintsifică V. Adamachi*, Jassy, Vols. 3, 4, and 5).

[411] For biographical note see *Bul. Soc. Reg. Române de Geogr.*, Vol. 37, 1916–18, pp. 678–679.

[412] Die untere Donau zwischen Turnul-Severin und Braila: Geomorphologische Probleme, Diss. Univ. Berlin, 1911.

[413] W. M. Davis in literatura geografică contimporană, *ibid.*, Vol. 34, 1913, No. 1, pp. 175–179; Asupra teraselor aluvionare, *ibid.*, No. 2, pp. 17–26 (in German as: Über die Bildung der Alluvialterrassen, *Geogr. Anzeiger*, Vol. 12, 1911, pp. 101–103).

[414] România in transitul sud-est European, *Bul. Soc. Reg. Române de Geogr.*, Vol. 33, 1912, pp. 48–68.

[415] S. Demetrescu et al. Carte ethnographique des régions habités par les Roumains et les colonies étrangères qui s'y trouvent, 1 : 1,000,000, Paris, 1919.

[416] N. P. Comnène: La terre roumaine à travers les âges: Atlas historique, politique et ethnographique, 20 maps in 1 : 4,150,000, Lausanne and Paris, 1919.

[417] N. P. Comnène: La Dobrogea (Dobroudja): Essai historique, économique, ethnographique, et politique, 208 pp., with 10 maps, Lausanne and Paris, 1919; N. Iorga, G. Vâlsan, et al.: La Dobrogea roumaine: Études et documents, 176 pp., separate from *Bull. Inst. pour l'Étude de l'Europe Sud-orientale*, 1919 (for contents see *Bul. Soc. Reg. Române de Geogr.*, Vol. 37, 1916–18, pp. 630–631).

[418] România la conferintsa Păcii, *Bul. Soc. Reg. Române de Geogr.*, Vol. 39, 1920, pp. 223–237.

The Rumanian Geographical Society's activities have been guided by a body made up largely of men in government administration and of professional geographers. Dr. S. C. Hepites, one of the vice-presidents, was formerly director of the Rumanian Meteorological Office. Professor Mehedintsi is head of the Educational Section and Professor Vâlsan is on the Editorial Committee. There is also a Military Section, presided over by General Iannescu. It is at present devoting itself to the creation of a Cartographic Museum;[419] valuable collections have already been donated by the French and Italian war offices. Another undertaking contemplated by the Society is a bibliography of Rumanian geography.[420] The society is in a flourishing condition, its membership having increased from less than 400 in 1913 to 1500 in 1920. In 1914, on the death of King Carol I, its late president, it received a bequest of 300,000 lei.

## Yugoslavia

In Yugoslavia universities with incomplete faculties have been created since the war at Lyublyana (Laibach), Subotica (Maria Theresiopel), and Skoplye. Geography is represented only at the existing universities of Belgrade and Zagreb (Agram). At Belgrade the subject has been raised to a high state of development by Professor Jovan Cvijić, well known for his work alike in physical and in human geography, recent illustrations of which are his critical elaboration of the cycle of erosion in a karst region[421] and his excellent book on the human geography of the Balkan Peninsula.[422] In 1910 through the instrumentality of Professor Cvijić the Serbian Geographical Society was founded. Since 1912 it has published a journal (*Glasnik Srpskog Geographskog Društva*) of which six numbers have appeared, the last two in 1921. The *Glasnik* is replete with papers of scientific value on all phases of the geography of the Balkan Peninsula. Associated with Professor Cvijić as professor of geography is B. Milojević. Climatology (P. Vujević) and ethnology (T. R. Djordjević and J. Erdeljanović) are also represented. Likewise with Serbia French geography had close ties in the person of the late Gaston Gravier, a pupil of Demangeon and lecturer at the University, whose death on the battlefield cuts short the career of one who promised to develop into the foremost Western authority on the geography of the Serbian lands.[423] At Zagreb geography is represented by a professorship (Milan Šenoa, who has specialized in oceanography and re-

[419] For detailed plan see Misiunea Muzeului Cartografic al Societătsi Regale Române de Geografie, *Bul. Soc. Reg, Române de Geogr.*, Vol. 37, 1916–18, pp. 418–520.

[420] *Ibid.*, Vol. 36, 1915, pp. 859–860.

[421] Hydrographie souterraine et évolution morphologique du karst, *Recueil des Trav. de l'Inst. de Géogr. Alpine* (Grenoble), Vol. 6, 1918, pp. 375–426. Abstracted by E. M. Sanders: The Cycle of Erosion in a Karst Region (after Cvijić), *Geogr. Rev.*, Vol. 11, 1921, pp. 593–604.

[422] La péninsule balkanique: Géographie humaine, Paris, 1918. For advance chapters in English see *Geogr. Rev.*, Vol. 5, 1918, pp. 345–361 and 470–482, and abstract of section on natural regions, *ibid.*, Vol. 9, 1920, pp. 199–204.

[423] Cf. his "Les frontières historiques de la Serbie," Paris, 1919 ("ce livre faisait présager un maître") and "La Choumadia," *Ann. de Géogr.*, Vol. 30, 1921, pp. 271–287, 351–361. Biographical notices in *Ann. de Géogr.*, Vol. 23–24, 1914–15, pp. 454–458, and *Glasnik Srpskog Geogr. Društva*, No. 5, p. 313, 1921.

cently contributed a bibliography of the geography of Croatia and Slavonia)[424] and assistant professorships in mathematical and physical geography (A. Gavazzi) and meteorology and climatology (A. Gilić, A. Mohoravičić, the latter also director of the Institute of Meteorology and Geodynamics).

## Bulgaria

Geography is well represented at Bulgaria's only university, the University of Sofia, by Professor A. Ishirkov, a pupil of Ratzel, assisted by J. Radev. Professor Ishirkov has been an active writer, and his works are known in Western Europe, as they are accessible in German and French. The substance of several of his earlier studies is contained in his main work, a two-volume geography of Bulgaria.[425] In addition two papers on the settlements and the ethnography of the Bulgarians are of interest.[426] Several recent publications on the Dobrudja were called forth by the peace conference.[427]

## Greece

At the University of Athens, the only university in Greece, geography is not represented. Some geographic work has been done by D. Eginitis, professor of astronomy. He has written on the climate of Athens and Attica.[428] The only other modern geographical work presumably by a Greek which is known to the writer is a monograph on eastern Crete by Dr. Leonidas Chalikiopoulos[429] of Cairo, who took his degree under Richthofen.

## Conclusion

Even a cursory examination of the geographical work being done in Europe cannot but impress one with its variety, breadth, and truly geographical spirit. To the professional geographer it is an inspiration, a confirmation of his faith. From it he can draw strength to rededicate himself to his task. Recent events have roused general interest in his subject and led to a more widespread appreciation of its value and mission. Contact with the thought of his fellow-workers abroad will help him keep properly equipped for the wider opportunities for service of the new time. For us in America this contact, to our good fortune, has constantly become closer, especially in the last ten or fifteen years. International excursions and congresses, exchange professorships, and co-operation in various enterprises

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[424] Geografska bibliographija za Hrvatsku i Slavoniju, *Glasnik Hrv. Prirod. Društva*, 1917.

[425] A. Ischirkoff: Bulgarien: Land und Leute (in series: Bulgarische Bibliothek), 2 Vols., Leipzig, 1916–17.

[426] Die Bevölkerung in Bulgarien und ihre Siedelungsverhältnisse, *Petermanns Mitt.*, Vol. 57, II, 1911, pp. 117–122 and 179–185; Ethnographische Karte des Bulgarentums auf der Balkanhalbinsel im Jahre 1912, *ibid.*, Vol. 61, 1915, pp. 339–343, With map, 1 : 500,000, Pl. 44.

[427] A. Ichirkoff: Les Bulgares en Dobroudja: Aperçu historique et ethnographique, With map in 1 : 750,000, Berne, 1919; A. Ichirkov and others: La Dobroudja: Géographie, histoire, ethnographie, importance économique et politique, Sofia, 1918.

[428] To klima tes Hellados, 2 Vols., Athens, 1908; Le climat de l'Attique, *Ann. de Géogr.*, Vol. 17, 1908, pp. 413–432.

[429] Sitia, die Osthalbinsel Kretas: Eine geographische Studie, *Veröffentl. des Inst. für Meereskunde Univ Berlin*, No. 4, 1903.

have cemented personal ties; European contributions to our journals and our increasing study of European publications, in which the language barrier has proven less formidable than it sometimes appeared, have aided the interchange of thought. It is to our own interest to foster this interchange and thereby add the stimulus of other points of view to that native genius which promises to make American geography of ever increasing value in the advancement of knowledge.

*March, 1922*

# GEOGRAPHICAL RECORD

## AMERICAN GEOGRAPHICAL SOCIETY

**April Meeting and Elections to Fellowship.** At the April meeting of the American Geographical Society held on the 25th of the month at the Engineering Societies' Building, 29 West Thirty-ninth Street, Mr. John W. Davis, late Ambassador to Great Britain, spoke on the history of the boundary between Canada and the United States. His address, which was entitled "The Unguarded Boundary," will be printed in the October number of the *Geographical Review*.

At the March and April meetings, President Greenough presiding, there were presented with the approval of the Council the names of 247 candidates who were duly elected as Fellows of the Society.

**Award of the Charles P. Daly Medal to Sir Francis Younghusband.** The Charles P. Daly Medal of the American Geographical Society for 1922 has been awarded to Lieutenant-Colonel Sir Francis Younghusband, President of the Royal Geographical Society. It has been forwarded through the Department of State for presentation at London by the American Ambassador. An account of the ceremony will be given in a later issue of the *Review*. The medal bears the inscription

Lieutenant-Colonel Sir Francis Younghusband
For explorations in northern India and
Tibet and for geographical publications
on Asiatic and African borders of the Empire

**The American Geographical Society's Index to the Journal of Geography.** Last January the *Journal of Geography* celebrated the twenty-fifth year of its foundation by the publication of an "anniversary number" containing articles on the history of geographical education in America in this period and the part played therein by the *Journal*. The Foreword is by Professor Davis, recognized leader in the movement that gave birth to the *Journal*. Professor Dodge, than whom through his long years of editorship no one has done more for the *Journal*, gives "A Glimpse of the Past." His successor, Professor Whitbeck, deals with "The Journal in the Field of Education," and Professor Brigham with "A Quarter Century in Geography" (see also his paper "Geographic Education in America," *Ann. Rept. Smithsonian Instn. for 1919*, Washington, 1921). Other phases of educational geography are discussed by Professors Goode, Fenneman, Jefferson, and Miller.

The aims and progress of the *Journal* have always been followed with a sympathetic interest by the American Geographical Society, and at a critical time in the history of the magazine publication was taken over by the Society (1919–1920). The *Journal* was then acting as official organ of the National Council of Geography Teachers, founded a short time previously. By 1920 this organization had advanced to the stage when it was deemed advisable to transfer the *Journal* to its auspices, and this was accordingly done with provision for substantial financial support from the Society until July 1, 1922. The Journal is now under the editorship of George J. Miller, Secretary of the National Council of Geography Teachers.

While the *Journal* was in the hands of the American Geographical Society it was planned to compile an index covering the entire series of volumes. This has now been completed and is published in co-operation with the National Council of Geography Teachers. The index extends over the 25-year period, 1897–1921, and includes the first five volumes which were published under the title "*Journal of School Geography*" and the two volumes of the *Bulletin of the American Bureau of Geography* (edited by Professor E. M. Lehnerts), which latter publication was merged with the former in 1902 under the present title. The index numbers some 150 pages and is prefaced by a historical and descriptive introduction. Examination of the index reveals the large body of valuable material contained in the volumes of the *Journal*. Started in a period of great enthusiasm for the "new" geography, the *Journal* has included among its contributors geographers of note at home and abroad and among its contributions

material of permanent value. Illustration may be taken from the first five volumes. These include articles by W. M. Davis on "Home Geography" (reprinted in the January, 1922, number of the *Journal*) and several physiographic subjects; by R. E. Dodge on "Life on the Colorado Plateaus" and several papers on the teaching of geography; by R. DeC. Ward, "Climatic Notes made During a Voyage Round South America" and "The Climate of the Philippines;" by E. C. Semple, "Influences of the Appalachian Barrier upon Colonial History" and "Indians of Southeastern Alaska in Relation to their Environment;" by A. P. Brigham, "The Eastern Gateway of the United States;" by Collier Cobb on "North Carolina" and L. C. Glenn on "South Carolina"; by J. F. Chamberlain on "Southern California" and C. F. Marbut on "Missouri"; by G. K. Gilbert on "Origin of the Physical Features of the United States;" by W. S. Monroe, "Geographic Instruction in Germany;" by Mark Jefferson on "Caesar and the Central Plateau of France;" by F. P. Gulliver on "Vienna as a Type City." Other contributors are C. W. Hayes, F. H. Newell, N. M. Fenneman, J. P. Goode, G. D. Hubbard, F. V. Emerson, and I. C. Russell. Of foreign geographers contributing to these first five volumes we have Douglas Freshfield, "The Exploration of the Alps;" Edward Heawood, "The Egyptian Sudan and its History;" A. J. Herbertson, "Geography of Scotland;" R. H. Mill, "The Development of Habitable Lands" (reprinted), and papers by L. W. Lyde, A. Silva White, and G. G. Chisholm.

A copy of the index will be sent upon request to Fellows of the Society and to institutions exchanging publications with the Society.

**Joint Meeting of the Association of American Geographers and the American Geographical Society.** The sixth joint meeting of the Association of American Geographers and the American Geographical Society was held at the home of the Society in New York on April 28–29. President Greenough of the Society called the meeting to order, and President Barrows of the Association presided. There was an informal dinner at the Belleclaire Hotel on Thursday evening, April 27, and a round table conference on "Methods and Problems in the Study of Land Utilization" on Friday evening, April 28. The conference was well attended. Among the guests were Secretary Wallace of the Department of Agriculture, Professor Gautier of the University of Algiers, Professor Brouwer of the Delft Polytechnic Institute, Holland, Mr. Mendenhall of the Land Classification Board of the U. S. Geological Survey, Messrs. Taylor and Baker of the Office of Farm Management, and Mr. Smith of the Forest Service. The conference ended with an appeal from Mr. Taylor for co-operation in solving land problems before the Department of Agriculture and the appointment of a committee of the Association with that purpose in view. The program of the meeting follows:

VILHJALMUR STEFANSSON: Colonizing the Lands Beyond the Treeline.
ALFRED H. BROOKS: The Future of Alaska.
H. N. WHITFORD: Present and Prospective Use of Tropical Lands and Tropical Forests as Illustrated by the Philippines.
OLIVER E. BAKER: The Problem of Land Utilization and Its Geographic Aspects.
CARL O. SAUER: The Problem of the Cut-Over Pine Lands of Michigan.
HUGH H. BENNETT: The Soils of the Southeastern States and Their Utilization.
ROUND TABLE CONFERENCE: Methods and Problems in the Study of Land Utilization.
E. F. GAUTIER: Native Life in French North Africa.
H. A. BROUWER: Physical Features of the Dutch East Indies.
C. W. BISHOP: Geographical Factors in the Early Culture Development of Japan.

Abstracts of all of the papers will be published in the next volume of the Annals of the Association, and several papers, notably those of Messrs. Gautier, Brouwer, Bishop, and Baker will be printed in the *Geographical Review*. Mr. Stefansson's paper dealt with problems already fully presented in the "Friendly Arctic" and in a later volume, to be issued in August, entitled "The Northward Course of Empire." Mr. Brooks' paper was illustrated by a series of maps giving the various distributional elements in the geography of Alaska.

Mr. Sauer's paper dealt chiefly with the political features of a local problem that in one way or another has vexed Michigan since the days of the great lumber barons. Mr. Whitford's paper, like those of Messrs. Baker and Bennett, was an excellent example of the geographic treatment of land use and soil problems in relation chiefly to agriculture. These three papers were also of interest as continuing the earlier work of Brewer, Hilgard, Whitney, Shaler, King, and others. The original quality of Marbut's geographical work on the Soil Survey, the recent work of Marbut and Shantz in Africa (to be published by the Society,

together with maps on the scale of 1:10,000,000, in color), of Jefferson in Argentina and of McBride in Mexico (to be issued as monographs in the Research Series of the Society) are other examples of the recognition of the importance of a study of land problems, including soils, in geographical work. It is important to emphasize the point of historical continuity in the development of the science of soil geography because of ill-founded and misleading assertions recently put forward respecting ignorance of the subject of soil geography among geographers and its representation in a college curriculum for the first time in 1921! The "new" in geography has become almost a fad, and we are apt to overlook the fact that the recognition of soils and of other land problems in the study of man is new only to those who have but newly "discovered" its importance. As a matter of fact we are but advancing a study first established in the United States by Hilgard before the Civil War ("Geology and Agriculture of the State of Mississippi," 1860) and given wide practical recognition in this country first in 1884 by Hilgard in "Cotton Production of the United States," a work which forms the fifth and sixth volumes of the final report upon the Tenth Census, and in later years, especially in the present century, by many others.

## NORTH AMERICA

**The Interior Forests of Alaska.** A contribution to the much discussed subject of the future of Alaska's resources is made by John D. Guthrie in an article "Alaska's Interior Forests" in the April number of the *Journal of Forestry*. The interior forests present a problem quite different from that of the coast forests. The latter, included for the most part (90 per cent) as National Forests, are comparatively well known; they have played an important part in local development and have an undoubted future in export trade (see the note on Alaskan Forests in the *Geogr. Rev.*, Vol. 1, 1916, pp. 216–217). Knowledge of the interior forests is scant and incidental but sufficient for broad description and the formulation of a definite policy in regard to their exploitation and protection. These forests are entirely unlike those of the coast in size, density, and species of trees. They constitute a woodland type comparable to the forests of northern Maine and eastern Canada though inferior as to quality. It is estimated that they cover not less than 150,000,000 acres pertaining to the unreserved public domain and lying almost entirely within the basins of the Yukon and Kuskokwim Rivers. The most northerly limit of the forest in central Alaska stretches well beyond the Arctic circle—68° 50′. The average altitudinal limit of tree growth is 2,000 feet.

As a source of lumber the interior forests cannot compete with the coast, and, though the species are well suited to the production of pulp, transportation would be prohibitive. On the other hand it is urged that the forest resources are no more than sufficient for local needs should the mining and agricultural possibilities of the Alaskan interior be realized. Already in the region of Fairbanks there is a shortage of readily accessible timber for constructional purposes. This shortage is attributed in the main to fires, a particularly serious menace where an annual rainfall of less than 15 inches and summer days of 20 hours' sunlight render the forests highly inflammable. It is estimated that some 25,000,000 acres have been burned over already. Furthermore, reforestation is considered impracticable under the climatic conditions of the Alaskan interior.

**A Superpower System for the Region between Boston and Washington.** The signing of the armistice providentially delayed a rapidly approaching power famine in the northeast manufacturing district of the United States. That there is a problem of power shortage to be faced sooner or later in that district, however, as population and industry increase, is indicated by the rapidity with which the development of war industries absorbed the available power.

A survey of the resources and needs of the region has recently been made under the direction of W. S. Murray, and the report has been published as "A Power System for the Region between Boston and Washington," *U. S. Geol. Survey Professional Paper 123*.

The territory in which the survey was made—the "superpower zone"—lies between the thirty-ninth and the forty-fourth parallels of latitude and extends from the coast to approximately 150 miles inland, including parts of Maine, New Hampshire, Vermont, New York, Pennsylvania, Delaware, and Maryland and all of Massachusetts, Connecticut, Rhode Island, and New Jersey. One-fourth of the population of the United States is concentrated in this area, and in it are operated—mostly independently—315 electric utilities, 18 rail-

roads with 36,000 miles of single track, and 96,000 industrial plants. The zone has relatively small hydro-electric resources and maximum industrial power requirements. Close to it, however, lie some of the best coal fields of the country. The problem, then, is to conjoin the hydro-electric supply of energy with the steam-electric supply so as to produce a maximum of energy for a minimum investment of capital and a minimum operating expense and at the same time conserve the rapidly disappearing cheap fuels of the Appalachian coal fields. Figured on the basis of the increase in the use of power in the last ten years, the total energy required in the superpower zone for the year 1930 will be 31,000,000,000 kilowatt-hours, of which about 21 per cent can be supplied by water power. A co-ordinated system of generation and transmission is suggested, which, it is estimated, will be able to furnish this power at an annual saving of $239,000,000 over the present unco-ordinated system. The system recommended includes a plan for the generation of energy by steam at tidewater and on inland waters where there is a sufficient quantity of condensing water to be had, and also the utilization of all hydro-electric power that can be economically obtained from rivers within the zone or within transmission distance. The system is to be co-ordinated by 34 load centers for the distribution of the energy generated. The superpower system is urged not to supplant or even compete with the existing electric utilities but to co-ordinate and supplement them and thus to promote economy of generation and transportation.

Of interest in this connection are the new state power maps which are being published by the United States Geological Survey. These maps, on a scale of 1:500,000, show the location of power stations and transmission lines used in public service and the names of the public-utility companies. They are available for all of the New England states and also for New York, New Jersey, Maryland, Delaware, and the District of Columbia.

## EUROPE

**The Distribution of Cultivation in Sweden.** The absolute dot method of representing geographical distribution employed so successfully by Sten De Geer in his population studies of Sweden ("A Map of the Distribution of Population in Sweden: Method of Preparation and General Results," *Geogr. Rev.*, January, 1922) has been applied to the agriculture of the country by C. J. Anrick in a map entitled "Area under Cultivation in Sweden." On the map (scale 1:1,000,000) each square kilometer of arable land is shown by a square of one millimeter side. The data are derived from the official statistics of Sweden 1913–1920. Accompanying the map is a well illustrated description of the method and results ("Beskrivning till karta över Sveriges åkerareal, with English Summary of the Contents," *Sveriges Geol. Under-sökning*, Ser. B a, No. 10, Stockholm, 1921).

The cultivated area of Sweden comprises 38,235 square kilometers of arable land and 480 square kilometers of gardening land. Of the area below the tree line 11 per cent is cultivated. In Götaland and Svealand (southern and central Sweden) the arable land amounts to 20 per cent. In some limited districts in southern Sweden more than 90 per cent lies under the plow. This highly varying intensity of cultivation is clearly shown in the map.

The extension and distribution of the arable land is largely determined by the natural conditions. In southern Sweden the climatic conditions are most favorable, and the number of the cultivable plants is greatest. The different kinds of soils and their distribution and the different topography are of fundamental importance. Of importance also are the historical development and the length of time an area has been cultivated. More than one-third of the cultivated land has been laid under the plow during the last fifty years.

When the last land ice disappeared from Sweden the lower parts of the country were submerged below sea level or were covered by lakes. In the late glacial seas and lakes clay, silt, and sand were deposited; and now these districts of sedimentation, after having been elevated, form the principal areas of agriculture. Of the land now cultivated 74 per cent lies below the late-glacial marine limit. Next to the sediments mentioned, till is the chief agricultural soil, though its value, of course, varies greatly according to its character. Peat soil also is of importance.

In Figure 14 and in Plate I the author gives a generalized map of the distribution of the arable land. In the plate he also depicts the extent of the cultivation of wheat, rye, oats, and barley.

E. ANTEVS

**The Famine Belt of Russia.** The original famine belt of Russia extends from the north end of the Caspian northward to central Russia and thence in a broad belt eastward beyond the Ural Mountains. In Figure 1, below, the famine belt has been drawn as represented in a report of the American Relief Administration by Professor A. C. Coolidge, published in April, 1922. Upon it have been drawn the boundaries of the rainfall belts, and they serve to show the transitional situation of these borderlands, where risk of crop failure and famine is inevitable in dry seasons. In the *Geographical Teacher* (Vol. 11, 1921, p. 141), Unstead has given the average rainfall and temperature of Samara over a long period in contrast to the conditions of 1921 as follows:

| | Rain in millimeters | | | Temperature—Degrees C. | | |
|---|---|---|---|---|---|---|
| | April | May | June | April | May | June |
| Average 1903–20 . . | 27.0 | 38.8 | 46.9 | 6.4 | 16.2 | 23.7 |
| In 1921 . . . . . | 1.7 | 0.3 | 5.1 | 12.4 | 24.7 | 31.1 |

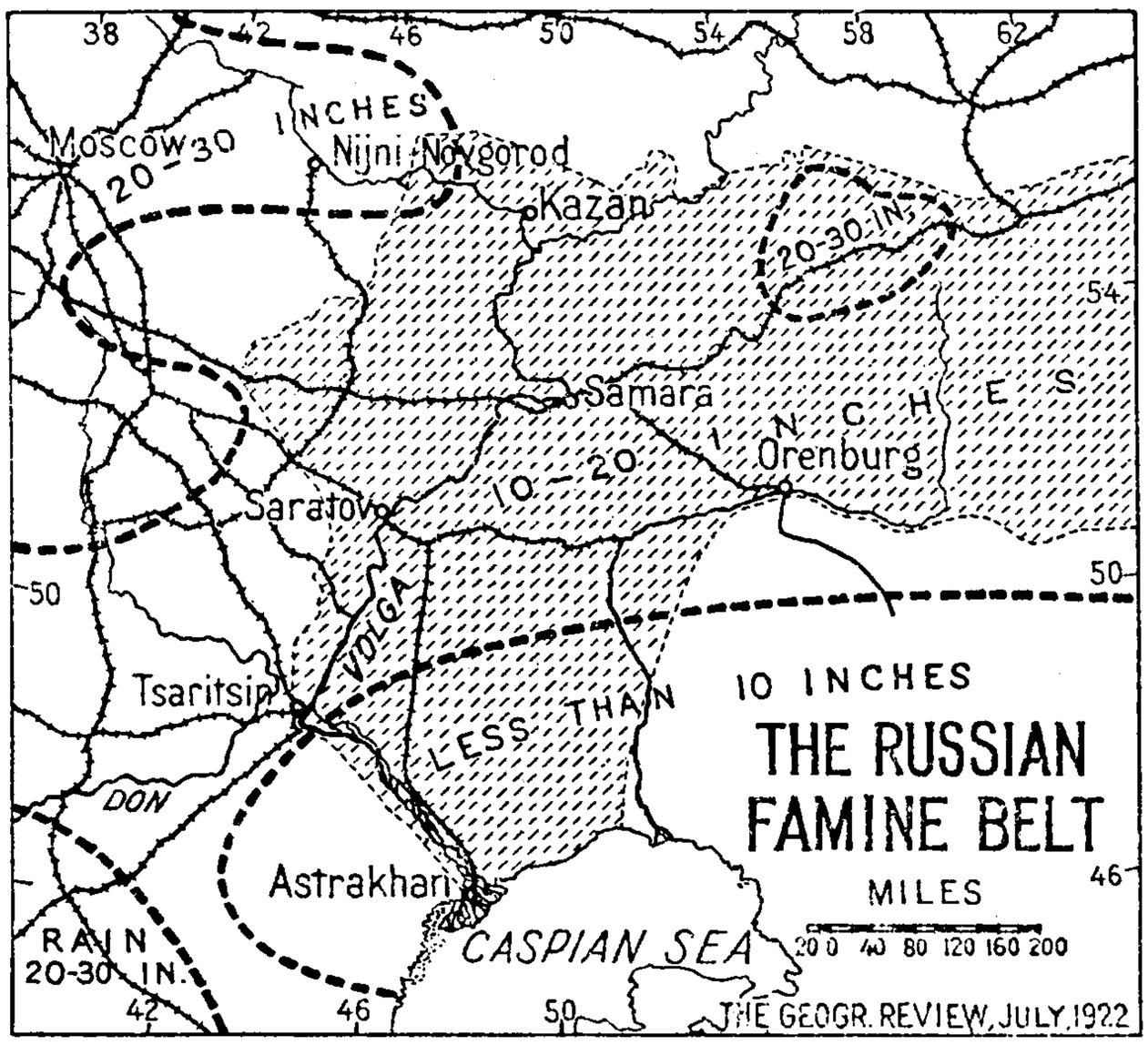


FIG. 1—Sketch map showing the famine area in Russia (shaded). Isohyets are added to show the "marginal" character of the Middle Volga basin, "naturally a rather poor grassland bordering an arid region."

It should be noted that though famine conditions first arose in the Samara region they have extended themselves over a wide district in the Ukraine, the Caucasus, and elsewhere. In the report of the American Relief Administration for May, Doctors Hutchinson and Golder report that: "In the eight or ten 'Governments' of Russia or the four 'Governments' of the Ukraine affected by famine, each one of which is comparable with the separate Transcaucasian republics in area and population, probably fifty per cent of the entire population is in serious want. In Georgia the percentage is not over two and one-half; in Azerbaijan, less than three and one-half; and even in Armenia, only twelve and one-half." They report further that contrary to the situation in Russia the lack of the Transcaucasian region is due to adverse political rather than climatic conditions, local wars interfering with ordinary agricultural pursuits. Armenia had deficient rainfall in 1921; Azerbaijan suffered from spring floods followed by hailstorms and a limited pest of locusts; and in Georgia early frosts in the fall of 1921 interfered to some degree with the autumn planting, and unusually heavy late spring rains prevented the proper ripening of the chief crop, maize. In spite of this, however, the average yield for the whole of Georgia was not far below normal. The chief difficulty in the relief of the Russians of the famine district is owing to congestion at the ports. It is impossible to evacuate food supplies as rapidly as they are received, and local congestion on the rail routes to the famine district further increases the delay. In continuation of this subject the reader is referred to the two following notes on agricultural conditions in eastern Europe and the historical geography of the Black Earth region.

**Overpopulation in Relation to Agriculture and Famine in Eastern Europe.** An exceptionally valuable analysis of the general agricultural conditions that underlie the state of famine now prevailing in eastern Europe is afforded by E. Dana Durand, former Director of the United States Census ("Agriculture in Eastern Europe," *Quart. Journ. of Economics*, February, 1922, Vol. 36, pp. 169–196). In his view the poverty of the masses is due "more to overpopulation than to any other one cause, if not more than to any of the other causes combined." Valuable comparisons are made between the density of population in the United States and those in Congress Poland, Galicia, and European Russia. It is shown that a far larger proportion of the population of eastern Europe is engaged in agriculture than is the case in the United States. Whereas, in 1920, 49 per cent of the population of the

United States was rural, in Congress Poland the figure was 68 per cent, in Galicia 80 per cent, and in European Russia 86 per cent. The number of rural inhabitants per square mile in the United States as a whole in 1920 was 17.3 (in Iowa, 27.4); in Congress Poland, 183; in Galicia, 213; in European Russia, 58; and in many sections of the country the rural density was from 100 to 150 per square mile.

Lacking industry to a high degree, eastern Europe with a very dense population must have a large part of its people work upon the soil. The result is a very minute division of the land to accommodate the individual farmer, and this division is enforced by scattered holdings absurdly small in size due partly to divided land inheritance generation after generation, partly owing to the subdivision and periodic redistribution of communal fields, and partly owing to the preference for land acquired by inheritance rather than land acquired by purchase because of a belief in greater security of title. Under these conditions a proper crop system cannot be maintained because the smallness of the holdings requires group action in sowing and harvesting crops. The alternative would require the individual to cultivate his tiny strip independently with tremendous loss of space and time. Farm animals are reduced in number to far below the level of efficiency, the low grade of living and the hopeless economic situation of the peasant conspire to foster primitive methods, and the consequence is that the average production of grain per acre is only little more than half as much in European Russia as in the United States, and the production per capita is far lower still. With his small holdings the peasant is required to consume the grain that he raises rather than to turn it into meat. Live stock is comparatively unimportant; there is a consequent lack of fertilizing manure; and the peasant is forced to be idle most of the winter, his productive efforts being confined for the most part to the crop season. The author wisely says that under these circumstances the export of grain represents an export from poverty and not from wealth of agricultural production. Its so-called surplus shown by export represents the contribution of agriculture to the state or to landlords in the form of taxes, rents, or profits of large estates. Even under these circumstances Poland had before the war hardly any net exportation of grain at all. Even in Rumania and Bulgaria, with less dense population, the greater part of the production of agriculture was consumed by the farming population itself.

The total effect of these circumstances was that agriculture was maintained in a state of delicate balance and that the peasant was almost always on the verge of want. The slightest accident might betray him. When war and revolution came with its reduction of agricultural output, its displacement of population in a region where industry had developed only in a limited way, disaster was bound to follow. Moreover, the city had nothing to give. The mining and manufacturing industries were more disturbed by the war than agriculture. The Soviet authorities followed the policy of requisitioning from the peasants their entire surplus and of suppressing entirely free trade of food. This was a blunder which had to be corrected. There was substituted a tax in kind, after which the producer was free to sell his grain. Added to these causes of disorganization was the lack of motive to produce. As a climax came the great drought in the Volga basin.

But if agriculture in eastern Europe has fallen, says Durand, it had not far to fall, and by the same token it has not far to rise again. By 1921 Poland, Rumania, and Yugo-Slavia were able to export food, though in small quantities, and there is promise of increase of efficiency in agriculture except in Russia. There, even if a stable government is soon established the recovery will take long because agricultural ruin has been more complete through the loss of machinery, tools, and draft animals, as well as the loss in confidence on the part of the peasant in any system of government. Added to these difficulties is the fundamental difficulty of the excessive density of the population which may affect all progress for decades and possibly for centuries. A large amount of labor exists but it is confined to small limits and is applied with a low grade of skill. Plowing methods are inadequate, and there is an improper rotation system and a wasteful practice of leaving land fallow every third year. Unless the people learn to restrict their numbers they may find it impossible ever to raise their standard of living, even with all of the large estates divided among them. Division of estates in itself will not solve the problem. The laborers on the estates must have their share. Some expense is necessary in equipping additional land, and though the large estates made up a large part of the total land area (in Poland 40 per cent) the large holdings include relatively small percentages of the total arable land (in Poland 25 per cent). The effect of the division of the land is to take away a source of irritation and to make possible a redistribution that will enable the peasant to consolidate his holdings

and make more effective the application of his labor. All this will necessarily involve the population in at least some confusion; and though the ultimate effect may be beneficial, the immediate effect is so small as hardly to bear at all upon the famine problem or the likelihood of its recurrence.

**Steppe and Forest in the Settlement of Southern Russia.** In connection with the present famine problem of Russia may be mentioned an extremely interesting paper read before Section E (geography) of the Edinburgh meeting of the British Association for the Advancement of Science (A. M. Gillett: A Sketch of the Historical Geography of the Black Earth

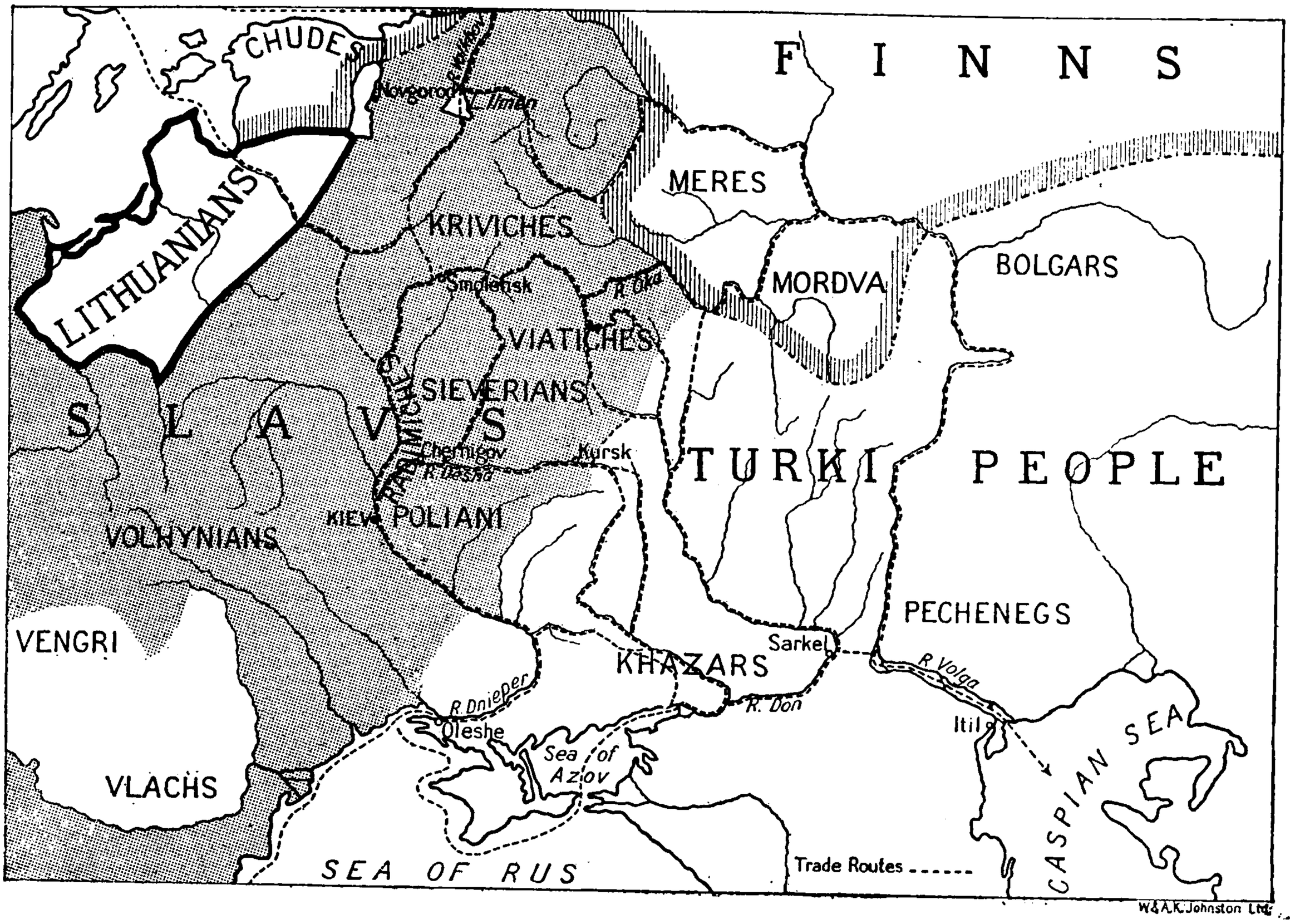


FIG. 1—Southern Russia in the ninth century, showing the peoples of Little Russia and the central Black Earth region. (Reproduced from the original drawing by the courtesy of the *Scottish Geographical Magazine*.)

Region of Central Russia, *Scottish Geogr. Mag.*, Vol. 38, 1922, pp. 1–10). The author considers as the pivotal fact of both early and later Russian history "that Russia is a plain open on the east by way of the Uralo-Caspian gate to the Asiatic influence which penetrated, almost entirely in the form of invasions of nomadic hordes, along the grassland route which led from the heart of Asia through southern Russia to the outposts of the steppe in Hungary." It was not altitude but vegetation that played the most important part. Asiatic nomads were confined to the southern steppe region; on the north they were limited by a belt in which the open steppe merged into forest. In this belt took place the struggle between the nomadism of the Tatar and the settled agricultural life that took root in the small clearings of the forest, where the Russian peasant had settled. The forest zone of northern Russia was occupied even in the centuries before Christ by a hunting and fishing people of long-headed Finnic stock, while the southern steppe zone was overrun by round-headed Asiatic invaders. The western neighbors of the Finns were Germans and Lithuanians; the Slavs were still concentrated on the eastern slopes and uplands of the Carpathians. The forest gave measurable protection to Slav and Finn alike, though the gradual advance of the Slav peoples caused a retirement of the Finns. The eastern Slavs were settled in the valleys of the middle and upper Dnieper "which from earliest times had served as the main north-to-south trade route across the western part of the Russian plain." Kiev as a trading town is located on the Dnieper at the point where the forests of the north merged gradually

into the southern steppe. The easternmost Slavs were a wild borderland people with the independent characteristics of frontiersmen. Their land was the battleground between the Slavs and the warlike steppe tribes, chiefly Tatar but with some Slav elements.

In the twelfth century the disruption of the Kiev community owing to social instability and nomad attacks developed two great streams of emigration: the one moved west to Galicia and Volhynia, which grew proportionately in importance; the other moved northeast toward the Oka and upper Volga, and the mixture of the latter stream of Russian colonization with the Finnish people resulted in the evolution of the Great Russian stock. Tatar invasions and supremacy from 1240 to 1480 delayed further colonization by both Great Rus-

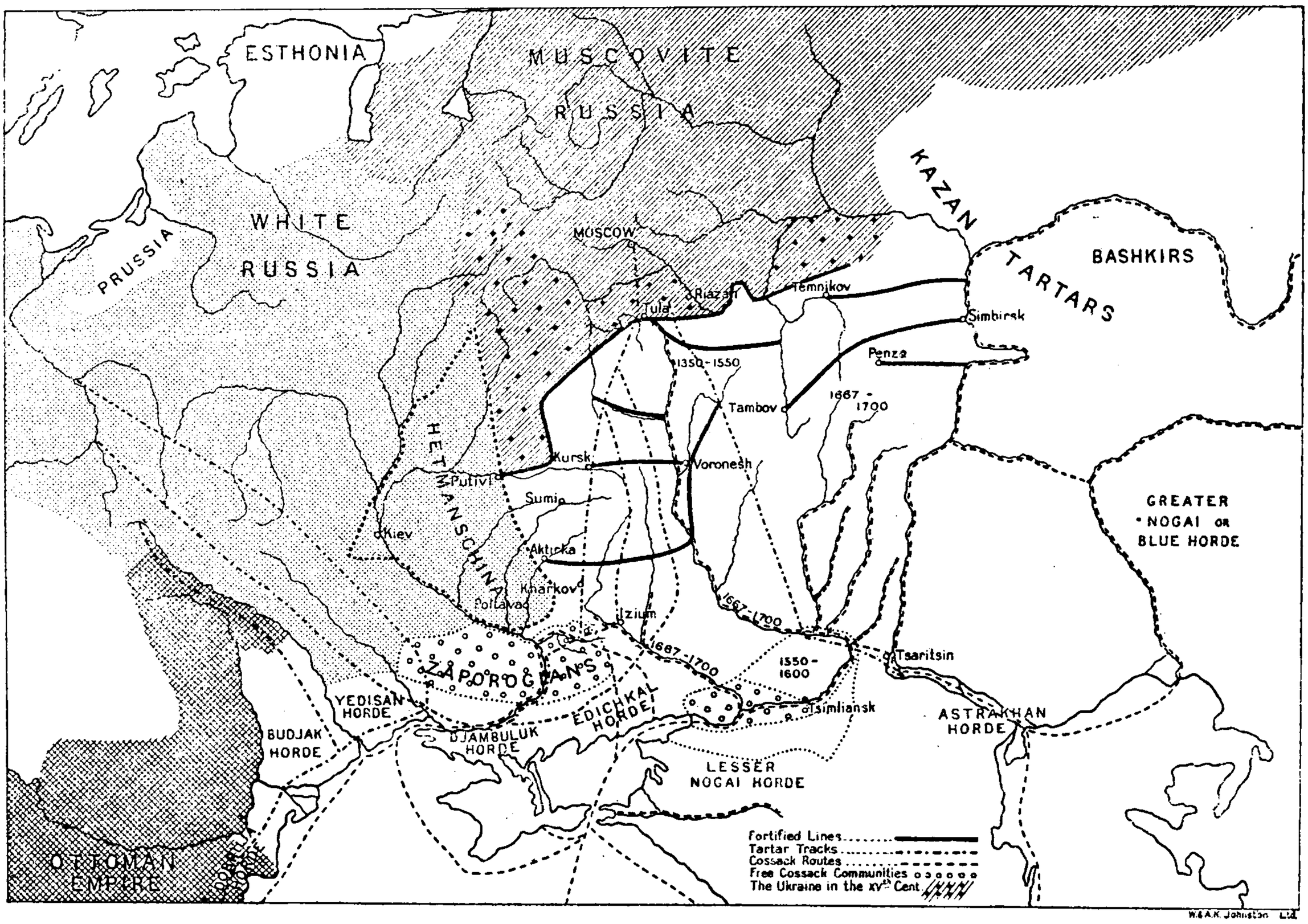


FIG. 2—Russia from the fifteenth century onwards, showing the advance of Great Russian colonization into the steppe. (Reproduced from the original drawing by courtesy of the *Scottish Geographical Magazine*.)

sians and Little Russians. When the Tatar yoke was thrown off in the fifteenth century there began a steady eastward territorial expansion preceded by Cossack outposts, which continued until the Russians stood at Port Arthur. Almost throughout the sixteenth century there was warfare on the southeastern frontier, where Tatar peoples continued to harass the Russian frontier. In the sixteenth and seventeenth centuries Great Russian colonization advanced behind the Cossack and a part of the scheme of defense was the construction of fortified lines designed to prevent Tatar penetration (Fig. 2). After the seventeenth century the Russian population increased in the steppe region by natural growth. In the eighteenth century all possibility of nomad raids was ended; Polish power declined. Cossack territory and Little Russia were included with the Moscovite Empire; the Don Cossacks were subdued. Settled life triumphed in the end. But, we may add, while it was a settled life it was still subject to catastrophes, like the present famine, that overtake the agriculturalist who makes his way beyond the border of the zone of safely habitable lands and takes his chances with the rain.

## AFRICA

**Boundary Settlement and Exploration in Wadai and Darfur.** Wadai and Darfur have been two of the last of the African states to pass under European control. In all the Sudanese

countries the European has encountered a determined opposition that is in line with a development superior to that of other parts of tropical Africa. Infusion of Hamitic and Semitic blood in the negro races of the Sudan and the superior military and political organization gained through the adoption of Islamism encouraged here the growth of powerful states. Wadai under direct Senussi influence was in particular one of the most fanatical of Mohammedan states. In 1895 Keltie predicted that it would prove "one of the most difficult of all the African states to deal with," and the truth of his prediction was verified to the cost of France. Britain likewise owed her Sudanese troubles of the 80's to the Mahdi who started his disastrous career in Darfur.

It was after the defeat of the Mahdi's successor, the Kalifa, at Omdurman that France and Britain agreed upon the general disposition of the eastern Sudan (Convention of 1899): the Anglo-Egyptian Sudan was to include Darfur, Wadai to form part of French Equatorial Africa. Senussi influence soon provoked attacks on the French posts in Wadai, and the country was not pacified until 1912. It was during the military operations of 1909 that Lieutenant Boyd Alexander, the African explorer, was killed on the frontier. In Darfur quiet was maintained by a noncommittal policy, the while little confidence was placed in the Sultan, Ali Dinar, a caution justified by the events of 1915 when he threw in his allegiance with Turkey. "The difficulty lies not so much in fixing the frontier as in assuring respect for it when defined," wrote Frank R. Cana (Egyptian and Sudan Frontiers, *Contemporary Review*, May, 1914, pp. 688–797). The agreement of 1899 had definitively fixed the frontier south of 11° and north of 19° 30′. Between 11° and 15° the line was in principle that separating the kingdom of Wadai from the province of Darfur as it was in 1882, that is before the Khedive lost control of the Egyptian Sudan. But the ownership of the frontier country, especially the districts occupied by the Tama and the Masalit, was disputed by France and England. According to agreement of September 8, 1919, Dar Tama has been assigned to Wadai, Dar Masalit to Darfur (*L'Afrique Française*, Feb., 1920, pp. 55–57; *La Géographie*, Vol. 35, 1921, pp. 390–391). In the actual delimitation of the boundary on the ground it is provided that due regard be given to native rights—specifically in regard to water supply—and interests; and for the more northern portions the terms are elastic enough to meet the exigencies of an arid region occupied by scattered tribes whose customs and habitat are still very imperfectly known.

Settlement of the boundary question is a step towards realization of the possibilities of these lands which though semi-arid in the north are fertile in the south and offer great scope for agriculture proper as well as cattle breeding. Improvement of communications is another desideratum. El Fasher, the capital of Darfur, is 600 miles from Khartum, and the projected railway remains to be constructed for two-thirds of this distance; Abeshr is nearly as far from the forts of the Shari basin and exceedingly remote from any commercial center or market. Sir Philip Brocklehurst, who recently crossed Wadai from his frontier post in Darfur, describes the difficulties experienced by the French officials in obtaining stores at Abeshr ("Across Wadai," *Geogr. Journ.*, April, 1922). For the most part dependence has to be placed on Greek and Syrian merchants trading from Khartum. The road they travel—through Kordofan, Darfur to Abeshr—is now chiefly frequented by pilgrims making the journey to Mecca. In past times it figured as one of the great slave routes, the other being via the Kufara oases to Tripoli. With French occupation of Abeshr in 1909 the slave trade of which the capital had been the center ceased, and the town declined considerably. Another general cause of decline was the famine of 1914. The French authorities strongly urge construction of a railroad to link up the Sudanese countries. According to Sir Philip Brocklehurst the route along the pilgrim road from El Fasher through Wadai would offer little difficulty to such construction except in the mountainous portion of western Darfur. Here the line would run through a northern continuation of the Jebel Marra. Through Wadai the road runs through a generally level and scrub-covered country.

The Jebel Marra forms a part of the southeast-northwest trending watershed separating the Chad drainage from that to the Mediterranean, a belt of almost unknown highland regarding which our conjectures have been considerably modified as a result of Commandant Tilho's recent work in the Borku, Ennedi, and Tibesti regions north of Wadai (J. Tilho: The Exploration of Tibesti, Borkou, and Ennedi in 1912–1917, *Geogr. Journ.*, Vol. 56, 1920, pp. 81–99, 161–183, and 241–267). In particular he has shown that the mountains of Tibesti reach greater elevations—the highest peaks 10,700 and 11,200 feet—than was heretofore believed. Tilho, who continued his geodetic and topographic observations from these northern territories and established a liaison with the British work in Darfur, also ascribed a

much greater height to the unexplored summits of the Jebel Marra—9,000 to 9,800 feet instead of 6,000 feet. This mountain massif has more recently been penetrated by two British parties. In 1918 Captain H. F. C. Hobbs and Mr. J. A. Gillan ascended a peak in the southwest of the massif which altogether covers some 800 square miles and visited two lakes, the lakes of Deriba, previously known only by native report. The one lake, an object of superstitious awe to the natives, is regarded by them as an oracle. Ali Dinar is said to have sent messengers to consult it on the eve of his defeat by the British (H. F. C. Hobbs: Notes on Jebel Marra, Darfur, *Geogr. Journ.*, Vol. 52, 1918, pp. 357–363). In 1920 Captain H. Lynes and Mr. C. McConnel began a survey of the natural history of the massif, ascending from the same point as the previous expedition (*Sudan Notes and Records*, Vol. 4, 1921, pp. 119–137). They give altitudes for the massif on the order of those suggested by Commandant Tilho and much greater than are shown on Captain Hobbs' map. Thus the summit actually ascended was measured as 9,500 feet. This summit forms part of the rim of the great crater that constitutes the southwestern peak and rises at other points to still greater heights. The Deriba lakes lie within the crater—the salt lake on the floor of the main crater, the deep fresh-water lake within a more recent interior crater. Three biologic zones were recognized by Captain Lynes: the lower zone, up to 5,200 feet, characterized by vegetation of the thorny-prickly Sudan type; the upper zone, above 7,500 feet, which shows a marked change to temperate type; and between a sort of neutral zone. The lower slopes of the mountain are here barren and unpopulated, though the extent to which they are terraced indicates a formerly numerous population. The mountain people dwelling on the upper slopes are described as a shy, apathetic folk of low mental development. However, they live in well-built huts in fortified villages and are more advanced as cultivators than the people of the plains.

**The Exploration of Mts. Kilimanjaro and Kenya.** With the acquisition of the Tanganyika Territory (formerly German East Africa) the British have gained possession of Kilimanjaro, the highest mountain of Africa. Both of the great extinct volcanoes of East Africa, Kilimanjaro and Kenya, are now within the bounds of the British Empire. Kenya was ascended in 1899, and now Kilimanjaro has been successfully scaled by a British party. A brief account of the ascent made last October by four officials of the Tanganyika administration under the leadership of Mr. C. Gillman will be found in the *African World* for January 21, 1922, pp. 502–503, and in the *Geographical Journal* for May, 1922, Vol. 59, pp. 394–395.

The scientific exploration of Kilimanjaro, however, has been the work of the Germans. The first successful ascent was made in 1889 by Dr. Hans Meyer ("Der Kilimanjaro: Reisen und Studien," Berlin, 1900). Important investigations especially of the glacial features of Kibo, the main summit, were made by Dr. C. Uhlig in 1901 ("Vom Kilimandscharo zum Meru," *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1904, pp. 627–650 and 692–718) and by Dr. Fritz Jaeger in 1904 (in company with Dr. Uhlig) and in 1906 ("Forschungen in den Hochregionen des Kilimandscharo," *Mitt. aus den Deutschen Schutzgebieten*, Vol. 21, 1909, pp. 114–146 and 161–197). More recently (1912) a party led and equipped by Eduard Oehler remained three months on the mountain carrying out topographic and scientific researches of the first importance. A photogrammetric survey was undertaken of the areas above an elevation of about 9,000 feet, and careful observations were made of the meteorology, geology, physical geography, and glaciers. A popular narrative of the expedition was given by Oehler in *Zeitschrift des Deutschen und Oesterreichischen Alpenvereins* (Vol. 46, 1915, pp. 124–156); the photogrammetric survey was described by Oehler's associate, Dr. Fritz Klute, in *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* for 1921 (No. 3–4, pp. 144–151); and the scientific results of the expedition were discussed in an important monograph by Dr. Klute entitled *Ergebnisse der Forschungen am Kilimandscharo, 1912*, Berlin, 1920. The map on a scale of 1: 50,000 that was prepared from the photogrammetric survey accompany Dr. Klute's article and monograph.

The massif of Kilimanjaro, which covers an area of some 55 miles east and west by 35 miles north and south, was built by the action of three separate volcanoes along a line of structural weakness trending generally in an east-west direction. The slopes up to a height of between 11,500 and 14,500 feet coalesce and form one immense mountain mass culminating in the three cones of Shira (12,878 feet), Kibo (19,456 feet), and Mawensi (17,291 feet), the crests of which are separated by intervals of some ten miles. The crater form of Shira and Kibo, the western and central volcanic cones, may easily be recognized; but, owing to

the softer rocks which compose Mawensi, erosion by stream and ice has here progressed farther, producing a group of precipitous peaks.

From November to February Kilimanjaro is swept by the northeast monsoon: from March to October by the southeast trades. The summits of Kibo, Shira, and Mawensi rise well into the antitrades which here as elsewhere in this part of Africa blow from the northeast. The southeast trades are locally deflected so as to blow up the southern slopes of the mountain from the southwest. If Oehler's hypothesis is correct (it is accepted by Dr. Klute), this results from suction caused by the anti-trades passing through the gaps between Kibo and Shira and between Kibo and Mawensi.

The distribution and character of precipitation upon the mountain sides is determined in large measure by these winds, and in turn the details of surface morphology, glaciation, and vegetation cover depend upon the precipitation. In general it may be said that the highest parts of the mountain, like the steppes which surround it, are relatively arid. Maxima of precipitation are found at middle and lower altitudes, and in a belt of heavy precipitation which encircles the massif the greatest quantity of rain falls along the southerly and southwesterly slopes brought by the trades from the Indian Ocean.

Corresponding to the zone of greatest rainfall, a band of cultivated land encloses Kilimanjaro on all sides but the north, and at a higher elevation (6,200 to 11,800 feet on the south where widest) a girdle of primeval forest forms a complete circle. Dr. Klute believes that the lower border of the forest was determined by climatic conditions prevalent during a moister epoch. The forest once established, on account of its ability to retain moisture, has been able to maintain itself at a lower level than that at which it could establish itself under present conditions. Dr. Klute believes that the isolated patches of woodland now found in the cultivated area are remnants of a period when the forest extended even lower than it now does. Above the forest are grasslands, bushlands, and bare rocks; and on the summit of Kibo is an ice cap which sends out a row of small glaciers like fingers to the southwest.

The snow line is some 2,000 feet lower on the southern and southwestern sides of the cone than on the northern and eastern. The southerly side is not only less exposed to the dry anti-trades but is also open to moisture brought by the deflected southeast trades here blowing up the slope from the southwest. A study of the ice on Kibo led Dr. Klute to make some significant comparisons between the character of glaciation on volcanic cones like Kibo where the surfaces are convex and on mountains like the Alps that had reached a mature stage of dissection prior to the glacial period and where the surfaces are consequently concave. On the latter the snow and ice tend to converge into the valleys, here to accumulate to great depths forming cirques, and to flow off to much lower levels in long valley glaciers. On mountains of convex slopes the surface of the ice is greater in comparison with its volume, and the flow is divergent rather than convergent. Melting is accomplished more readily, and the lower limits to which the ice extends remain at a higher elevation even when climatic conditions are equal.

From a comparison of observations made by himself and others Dr. Klute asserts that the glaciers of Kilimanjaro have on the whole been receding during the past fifty to one hundred years but that this movement was interrupted during the first few years of the twentieth century when the ice front remained stationary. After 1906, however, recession was apparently resumed and, according to the reports of the English expedition of last October, has been in progress ever since (*Geogr. Journ.*, May, 1922, p. 395).

On Kilimanjaro, prior to the glacial period, well developed valleys had been excavated on Shira and on Mawensi. These became filled with ice during glacial times, and their upper extremities were converted into cirques. Cirques were also formed at elevations of 12,300 to 13,800 feet on the southern and southwestern exposures of Kibo, and a southwest-facing escarpment between Kibo and Shira shows that a series of semicircular glacial amphitheaters was occupied by small glaciers here, at approximately the same elevation.

From an examination of the terminal moraines of the glacial period Dr. Klute was able to trace successive stages in the withdrawal of the ice, but he could find no evidence of more than one distinct period of glaciation. The immense size of the cirques in comparison with the small stream valleys leading out of them seems to show that during the glacial period, as at the present day, the greater part of the run-off from melting ice was absorbed by evaporation. Glaciation then as now was developed on a vaster scale on the southern and southwestern sides of the mountain than on the opposite quarters. From this Dr. Klute concludes that the wind system of the glacial period must have been the same as that of the

present and that, if this be true, any shifting in the position of the poles or continents cannot be adduced as explanations of the incidence of the ice age.

From the human point of view Dr. Klute foresees an ever increasingly important rôle which the lowest slopes of Kilimanjaro are destined to play, despite their rain and clouds, as stations for sanitaria and refuges for convalescents from the more unhealthful coastal belt.

Kenya, lying approximately on the equator 210 miles to the north, still awaits thorough geographical investigation corresponding to that of Oehler and Klute on Kilimanjaro. In 1899 Mr. (now Sir Halford) Mackinder spent a month exploring the mountain and accomplished the first and only successful ascent of its highest point ("A Journey to the Summit of Mount Kenya, British East Africa," *Geogr. Journ.*, Vol. 15, 1900, pp. 453–486). During more recent years the Rev. Dr. J. W. Arthur has made five expeditions to the mountain but unfortunately has failed to reach the summit. The results of his explorations will prove of interest to both mountaineer and geographer (see J. W. Arthur: Mount Kenya, *Geogr. Journ.*, Vol. 58, 1921, pp. 8–25).

The height of Kilimanjaro—that is, of the highest point on the crater rim of Kibo called by the Germans "Kaiser Wilhelm-Spitze" and apparently not as yet rechristened by the British—was determined by Dr. Hans Meyer from barometric readings to be 6,010 meters (19,715 feet). This figure is probably somewhat excessive. The commission which surveyed the German-English boundary calculated the height by trigonometry to be only 5,890 meters (19,318 feet); and this is the figure which appears on the British General Staff map of 1915 (1:1,000,000). The Germans, however, claim that this represents the elevation of a point on the crater rim and not of the highest peak. Dr. Klute, from a combination of aneroid observations and from estimation, places the latter at 5,930 meters (19,456 feet), which is probably approximately correct (*Zeitschr. Gesell. für Erdkunde zu Berlin*, 1921, No. 3–4, pp. 148–149).

According to the British General Staff map of 1915 the height of Kenya is 5,195 meters (17,040 feet).

**The Vegetation of Madagascar.** The island of Madagascar is large enough and sufficiently varied in topography to afford conditions favorable for the development of many of the types of vegetation found on the adjacent continent of Africa. The prevailing southeasterly wind contributes to the maintenance of a luxuriant forest along the eastern slope of the island but since the watershed lies near the east shore there is a relatively small portion of the island, abundantly supplied with rainfall (see the relief map accompanying the article "Madagascar" by G. Grandidier, *Geogr. Rev.*, Vol. 10, 1920, pp. 197–222). On the northwest side of the watershed drought occurs following a rainy period sufficient to develop a good growth of grass. During the drought period this region is swept by fire, which not only prevents forests from invading the grassland but also pushes back the forests themselves where they come in contact with the grasslands. As on the African continent, a temperate rain forest extends along the top and down the east side of the watershed.

West of this forest region and extending around the south end and the north end as well is a region similar to the acacia-tall grass (low veld) areas of Africa where grasses predominate and where there are scattered trees. Fire destroys the grass almost every year and greatly limits tree growth. In the south and west the acacia-tall grass country gives way to a drier type similar to the thorn forest and acacia-desert grass areas of Africa. In the latter type fire is not a factor, since the growth of grasses is not sufficient to enable the fires to spread, and drought alone prevents the development of forests. Along the coasts there are mangrove swamps, and in the interior many marsh-grass areas.

Beginning in 1915 and continuing down to the present the Colonial Museum of Marseilles has published a notable series of botanical papers dealing with the French colonies. Of these, a number have dealt with the vegetation of the island of Madagascar. In a recent number Perrier de la Bâthie ("La végétation malgache," *Annales Musée Colonial de Marseille*, Ser. 3, Vol. 9, 1921) presents for the first time a concise picture of the vegetation of the island. The classification is unfortunately not based entirely on the vegetation itself. Division is first made into the original and the modified vegetation, and second, upon a climatic and physiographic basis the original vegetation is further divided into that found on the windward and that found on the lee side of the island. A map of the island shows the following types of vegetation: evergreen forest, deciduous forest, thorny brushland, mangrove, *savoka* (cut-over land), and prairie (burned-over grassland). On this map are

also drawn certain floristic lines separating different floral provinces, and two small maps give additional floristic data.

The original vegetation is now limited largely to the small area of forest which marks the east slopes of the watershed, forms a narrow strip in the south, but broadens out in the north and extends with many interruptions from coast to coast. Much of this original forest has been reduced to agricultural or cut-over land, and it now constitutes about 12 per cent of the area of the island. The brushland of the southwest is also regarded as of the original type, since here growth is not sufficient to enable fires to spread.

The greater part of the island—over fifty-one million hectares—is characterized by a modified vegetation which is classified under three main types, primarily according to botanical composition—the prairie, the *savoka*, and the mangrove. As a rule the number of species is small and a large proportion of the species are not endemic but are often world-wide in their distribution.

The prairie includes practically all the grasslands except the marshes, which are regarded as secondary. In this broad division are included both the luxuriant tall-grass prairies characterized by Andropogon and the desert-like short-grass lands characterized by Aristidas. These distinctions although not expressed on the map are of both economic and ecological significance.

The *savoka* is cut-over land which has partially reverted. Here are also included the early stages, represented by true ruderals which occur in cultivated fields or in fields recently abandoned, as well as the later stages in the succession leading to the re-establishment of the original forest.

The mangrove is also included in this section largely because it is characterized by a limited number of species. In fact the analysis here is based more largely on the botanical composition than upon the environmental conditions indicated by the plant types, and the grouping is therefore not well chosen to indicate crop potentiality.

The original vegetation is made up of a large number of species, many of which are endemic. This is divided on the basis of rainfall into the communities on the windward and leeward sides of the island respectively.

The vegetation of the windward side is divided into the eastern region,—a moist tropical region, the central region,—a region less moist and more temperate, and the region of Sambirano, warmer than the eastern region, but characterized largely by species from that region. The eastern region is characterized by high humidity and little change in weather during different seasons. In this region four formations are distinguished: (1) the littoral forest, largely developed on dunes and characterized by a low growth which produces construction timber, African ebony, and copal; (2) the marshes and lagoons; (3) the eastern forest, of complex botanical composition in which epiphytes are a prominent feature; (4) the mountain forests, constituting a type characteristic of exposed high mountains, where a large number of species occur and form a dense growth.

The forests of the eastern region are not readily destroyed by fire, but the greater amount of this forest has been cut and destroyed. Where reforestation takes place it passes through definite stages which must come in definite order and which require from 15 to 30 years to complete.

The central region comprises all areas above 800 meters and has a relatively temperate climate and less rainfall. Its limit is not well defined on the east but is relatively sharp on the west, where it is marked by the occurrence of deciduous trees. There are six formations in the central region: (1) the marshes, relatively abundant and characterized largely by sedges; (2) the dense forest, with herbaceous undergrowth, which lies between 800 and 2,000 meters elevation and represents a more temperate and somewhat less humid modification of the eastern forest; (3) the forest, characterized by an abundant lichen flora, which occurs only at high altitudes and is similar to the forests of the high mountains in the eastern part; (4) the ericaceous brushland, which also occurs at high altitudes where it represents the upper zone of vegetation on the island; (5) forests of the western slopes, relatively dry and very inflammable; (6) the rock xerophytes, where soil is denuded or thin and rock comes to or near the surface.

The formations of the central region are readily and rapidly destroyed by fire, and a few successive fires will reduce the forest to an Aristida prairie. In this destructive process the crests and ridges are first denuded, the other places retaining their original vegetation. In the next stage the forests occur only as small isolated clumps, and in the final stage the grassland replaces these isolated forests.

The remaining portion of the region on the windward side is discussed as the region of Sambirano. It is a small region on the northwestern side of the island where the forests of the east coast extend across to near the west coast. It differs from the remainder of the west coast in being much more humid and hotter. It contains forests of which three formations are distinguished, based on soil and topographic conditions as follows: (1) forests on alluvial land and at the edge of bodies of water; (2) forests on slopes and heavy soil; and (3) forests on sandy hills.

The vegetation of the lee side suffers prolonged drought periods. This part of the island is divided into western and southern regions. In the western region rainstorms and high temperature prevail for five months, followed by seven months of intense dryness. A large portion of this region occurs south of the region of Sambirano, and a small portion north which extends to the eastern shore some distance south of the north end of the island. In the western region six formations occur: (1) the raphia swamps, varying greatly in composition from pure Typha to palm swamps; (2) the alluvial forest, characterized by beautiful tall trees and little underbrush and distinguished from other formations of the western region by the abundance of lianas and by the persistent foliage; (3) the forests of the lateritic hills, consisting of small deciduous trees; (4) the forests of the calcareous plateau, characterized also by small or very large deciduous and thorny xerophytic tree growth in which Adansonia occurs; (5) the forests of the sandy hills, with xerophytic trees and bushes; (6) the xerophytic brushland, characterized by spiny and fleshy-stemmed plants such as Aloe, Euphorbia, etc.

The southern region is a xerophytic brushland, characterized by Didierea and other fleshy plants. Here fires cannot spread, and the vegetation can maintain itself against the encroachments of the prairie.

H. L. SHANTZ

## ASIA

**British Enterprise in Northern Baluchistan.** From the days of Alexander of Macedon down to the last decade of the nineteenth century, the country bordering on the northern frontier of Baluchistan remained almost utterly unknown to Europeans. A barren district, much of it a true desert inhabited by predatory Baluch nomads, it lay far from the beaten tracks of commerce and of war. Only when British India began to fear Russian influence from the north was a concerted effort made to bring law and order into these regions.

Much of the success of British policy there is due to the work of Colonel Webb Ware, who in 1897 was placed in charge of the territory along the Afghan boundary by Mr. Hugh Barnes. Mr. Barnes, now Sir Hugh, had taken a prominent part in the survey of the boundary in the previous year and at the time was agent to the Governor General in Baluchistan. Under Colonel Webb Ware's management most of the native tribes, excepting the Sarhadi, were pacified; and a telegraph and caravan route was established from Quetta to Robat, near where the frontiers of Persia, Afghanistan, and British Baluchistan meet. Commercially this route offered an easy line of ingress for British trade to the markets of Khorasan. Strategically it strengthened the Indian frontier and offered a base from which military action might be taken against Afghanistan should the necessity arise. It also enabled the British to intercept the dangerous traffic in arms between the Persian Gulf and the Indian borderlands. So flourishing did the trading by camel over this route become, that in 1905 the government of India constructed a railway from Quetta to Nushki to obviate a difficult ascent of some 3,000 feet which the camels had to make on their journey eastward. Early in the World War German and Turkish aggression in Persia, together with a shortage of camels, induced the Indian government to extend the railway to a point halfway between Nushki and the Persian frontier, and its final completion to this frontier was determined upon immediately after the Russian debâcle in 1917 and completed in 1919.

The whole matter of the Nushki Railway with its historical and geographical setting was discussed by Colonel Webb Ware in a lecture which he delivered before the Central Asian Society (London) and which was followed by illuminating comment from Sir Hugh Barnes (*Journ. Central Asian Soc.*, Vol. 6, 1919, pp. 44–92).

The Sarhad is a wild, mountainous tract lying between Persia and Baluchistan. It has at all times been the haunt of lawless, intractable tribes. Not long after the opening of the

caravan route, Persian Baluchistan threw off all semblance of Persian authority, and raiders from the Sarhad carried terror and devastation throughout the greater part of eastern Persia. It is a testimonial to the order established in Baluchistan that, in spite of these raids, the trade route, "which lay within a single day's easy march of their tribal headquarters was never touched until the spasm of unrest which followed the opening of the war passed over the country in 1915." The story of the final subjugation of the Sarhad raiders in 1916 is graphically and informally related by Brigadier General R. E. H. Dyer in his book entitled "The Raiders of the Sarhad," London, 1921.

## AUSTRALASIA AND OCEANIA

**Some Recent Studies in the History of Australian Exploration.** Though the main events in the history of Australian exploration have been recorded in easily available works, there still remain wide gaps in the record. Much attention has been devoted of late years by Australian geographers and historians to the filling in of these gaps, and the field is rapidly being prepared for the production of a history of far broader scope than any that has yet appeared.

Probably the best general introduction to published materials on Australian discovery and exploration will be found in those sections of the *Geographisches Jahrbuch* relating to Australia and to the history of geography from the close of the Middle Ages onward. These carry the student through the year 1908; but since that date investigation has been pushed forward vigorously, hitherto unpublished materials have been brought to light, reprints have been made from rare books, and many data previously uncorrelated have been gathered together in convenient form.

The whole question of the knowledge of Australia before the well authenticated Dutch voyages of the seventeenth century is highly treacherous and controversial ground upon which one must enter with caution. Some writers have even sought to associate ancient Greek speculations about vast southern lands with veritable knowledge of Australia, and an extremely dubious claim has been advanced in favor of the discovery of the western coast by the Frenchman, Paulmier de Gonneville, in 1503. There is a greater measure of probability in the supposition that the west coast may have been visited by the Portuguese and the eastern coast by the Spaniards in the sixteenth century (Ricardo Beltrán y Rózpide: Juan Fernández y el descubrimiento de la Australia, *Rev. de Geogr. Colon. y Mercantil*, Vol. 15, 1918, pp. 347–362).

The southern coast from Cape Leeuwin to the Nuyts' Archipelago was first explored by the Dutch in 1627 and was called by them Nuyts' Land. Ninety years later a curious proposal that this region be made the seat of a colony was presented to the Dutch government. The rare booklet of Jean Pierre Purry (1718) in which wholly theoretical arguments are advanced in favor of this scheme has been reprinted in part (*Proc. Royal Geogr. Soc. of Australasia: South Australian Branch*, Vol. 19, 1917–18, pp. 102–108). Purry maintains that because the Land of Nuyts lies "in the 5th climate, between the 30th and 36th degrees of latitude," and because the best and most fertile countries both of the Old and of the New World lie between these same parallels, that therefore the Land of Nuyts must be rich "whether in cheese, wine, olives, tobacco, or, chief of all, silkworms." Subsequent explorations by sea and land, however, have revealed this coast and the country behind it as among the most desolate and inhospitable regions in the world.

A useful summary of early voyages along the southern coast was given by the Hon. John Lewis in one of his annual addresses as president of the South Australian Branch of the Royal Geographical Society of Australasia (*Proc., etc.*, Vol. 19, 1917–18, pp. 1–95). By all means the most fruitful of these explorations was that of Captain Flinders in the *Investigator*. Flinders accurately surveyed the shore line and discovered the two great bays, Spencer's Gulf and the Gulf of St. Vincent, that penetrate far into the interior of South Australia. Full extracts from Flinders' detailed journal were given by President Lewis in the address just referred to and in that of the following year (*Proc., etc.*, Vol. 20, 1918–19, pp. 1–67). The best known incident of the voyage was an unexpected encounter south of Kangaroo Island with the *Géographe*. This vessel and the *Naturaliste*, both under the command of Captain Baudin, had been sent out by Napoleon Bonaparte to explore these southern waters. Though the Peace of Amiens had been concluded less than a month before, for all Flinders and Baudin knew, France and Great Britain were still at war.

Flinders, none the less, ventured aboard the French vessel, was received with courtesy by Baudin, and exchanged geographical information with the French commander. Subsequently Flinders was careful to preserve upon his maps names given by Baudin to points along the coast, and in 1913 the continued use of several of these names was officially approved by the South Australian government. On the other hand the official accounts of the French expedition written after the death of Baudin tended to deprive the British navigator of the credit due him for his pioneer work.

Though the first British settlement in Australia was made in 1788 at Sydney, the escarpment of the Blue Mountains to the west with its remarkable series of "bottle-neck" valleys for many years placed an effective obstacle in the way of exploration and expansion into the interior (see Griffith Taylor, *Geogr. Journ.*, Vol. 53, 1919, p. 177). During the infancy of the settlement at Sydney, a rumor became widespread among the convicts of the presence of a colony of white people some 150 or 200 miles back in the country. In 1798 two journeys were made under the command of Governor Hunter to investigate this rumor. Needless to say, no white people were found, but the district southwest of Sydney up to the mountain barrier near the site of the present city of Goulbourn was penetrated for the first time. The diaries of a young man who took part in these journeys have been recently printed and discussed in detail by Mr. R. H. Cambage ("Exploration beyond the Upper Nepean in 1798," *Journ. and Proc. Royal Australian Hist. Soc.*, Vol. 6, Part I, pp. 1–36). Not until the second decade of the nineteenth century, however, were more extended explorations undertaken on both sides of the Blue Mountain barrier and upon the plains to the west. In another interesting paper Mr. Cambage outlines and summarizes several significant journeys that were made at this time ("Exploration between the Wingecarribee, Shoalhaven, Macquarie, and Murrumbidgee Rivers," published by Royal Australian Hist. Soc., July 26, 1921).

The discovery of the great River Murray and the first passage overland from New South Wales to South Australia were made in 1829–1830 by Charles Sturt, who was later to open the way into the heart of the continent. Mr. Lewis, whose interest in the historical geography of Australia has been unflagging, in another Presidential address, dealt at length with the explorations of Sturt and others in the vicinity of the Murray and with early navigation on that stream (*Proc., etc.*, Vol. 18, 1916–17, pp. 2–74). A letter addressed by Sturt to the Under Secretary of the Colonial Office (R. W. Hay) and bearing the date 1834 was printed for the first time in the *Proceedings* (Vol. 18, 1916–17, pp. 89–104). Sturt pointed out the relative advantages and disadvantages of Port Lincoln and Kangaroo Island for prospective settlements and suggested that the strip of country between Mt. Lofty and the eastern shore of the Gulf of St. Vincent offered the most suitable site for the capital of a future colony. This was the site chosen only two years later by Colonel Light, to whom had been assigned the duty of selecting a location for the capital, and here the city of Adelaide was built. A well written account of the work of Sturt, Colonel Light, and other explorers of the coasts and interior of South Australia is given by Gwenneth Williams in a monograph entitled "South Australian Exploration to 1856" (Adelaide, 1919).

In spite of the construction of the telegraph line along the shore in 1877, Nuyts' Land of the Dutch (including the barren Nullarbor Plain, which, it would seem, is characterized by *karst* topography) remained only imperfectly known until as late as the opening of the transcontinental railway in 1917. One result of the popular interest in this district created by the building of the railway, was the publication in the *Proceedings* (Vol. 19, 1917–18, pp. 109–153), in the *Victorian Geographical Journal* (Vol. 30, 1913, pp. 1–17), and elsewhere, of many interesting data on explorations made there since 1860.

Among the more critical problems that face the Australian settlers after the preliminary reconnaissance of the country, is that of the removal of stock overland to remote quarters which it is hoped to develop for grazing. In 1838 Joseph Hawdon drove the first herd of horned cattle from New South Wales to Adelaide, a distance of over seven hundred miles, and was soon followed in the same undertaking by the explorers Sturt and Eyre. Letters describing these "overlanding" journeys of Hawdon, Eyre, and Sturt which first appeared in the *South Australian Gazette* in 1838 were reprinted in the *Proceedings* (Vol. 17, 1915–16, pp. 99–107). Since these early days numerous other "overlanding" expeditions have been carried out, often against desperate odds—as, for example, in the case of Kennedy and McGill who succeeded (1870) in driving a small flock of sheep westward around the head of the Great Australian Bight to the Nullarbor Plain (see *Victorian Geogr. Journ.*, Vol. 30, 1913, p. 3). Within very recent years a stock route has been opened from Willuna in Western Australia northeastward through more than six hundred miles of territory that had remained

almost utterly unknown until Canning's journey of 1907 (see *Western Australia Geol. Survey Bull. No. 61*, pp. 37 and 67–68).

## PHYSICAL GEOGRAPHY

**The Abyss of Cap-Breton, Bay of Biscay, and a New Explanation of the Origin of Submarine Trenches.** Under the title of "Le Gouf de Cap-Breton," Commandant Ch. Gorceix presents in *La Géographie* for April, 1922, a somewhat detailed description and a novel explanation for the trench or abyss which leads an arm of deep water into the Gulf of Gascony at the inner angle of the Bay of Biscay. This trench has usually been interpreted in the same way as the apparently similar trenches opposite the mouth of the Hudson and many other rivers, as a continuation of a river valley that was eroded during a time of continental emergence, and drowned by recent submergence. Hull, Spencer, and Davidson have treated this problem for the western coast of Europe, the eastern coast of North America, and the coast of California. Gorceix gives a detailed contour map of the Cap-Breton trench, from which it appears to have a form of much irregularity, quite unlike that of a normal valley; and he explains the trench as the result of solution of submarine beds of gypsum and salt by warm water fed by a subterranean river that flows westward along a belt line from the northern flank of the Pyrenees. In support of this explanation he refers to the geological structure of the region and quotes a record of warm water discovered in the trench bottom by a temperature sounding, but he adds that further soundings are needed before the presence there of warm water in considerable volume can be regarded as proved. In response J. B. Charcot has come forward with a note to the French Academy of Sciences (*Comptes Rendus*, No. 19, May 8, 1922, pp. 1246–1247) giving soundings made by the *Pourquoi Pas* in June, 1913, and July, 1914. These soundings show an absolutely regular and normal decrease in temperature as the bottom is approached.

The amount of continental emergence and submergence demanded by the explanation of these submarine trenches as river valleys is in some cases as much as 5,000 or 8,000 feet, and that alone makes the explanation seem improbable. If the emergence and submergence are explained as the result of an up-warping and down-warping of the submarine shelf, marginal to the continent, instead of as the result of a massive and uniform movement of an entire continent, the explanation might be regarded as less strained. But if other trenches are found to exhibit such irregularities as those which characterize the abyss of Cap-Breton, it may be advisable to explain them all as of submarine origin, without the aid of changes of level. In that case the relation often found between offshore trenches and on-shore rivers would have to be regarded as accidental; yet in several instances this relation is so close as to seem causal. The whole problem is evidently open rather than closed.

W. M. DAVIS

## GEOGRAPHICAL NEWS

**Establishment of an International Hydrographic Bureau.** A new evidence of international co-operation in matters of scientific interest and world-wide utility is to be found in the organization last year of an International Hydrographic Bureau situated at Monaco and supported by the governments of twenty-two maritime countries. By this step taken by the official hydrographic services of the various governments a number of aspects of the oceans and coasts now for the first time has become the subject of organized international co-operation. Official collaboration in such matters in the past has been limited chiefly to the exchange of charts by the leading national hydrographic offices. Men of science for a number of years have worked together in the study of oceanography in its biological and in many of its physical aspects. Thus the International Council for the Study of the Sea has been in existence since 1901 and has conducted a number of valuable researches. International oceanographical congresses have been held on several occasions since 1899; while the Prince of Monaco, largely by his own effort, has succeeded in compiling the uniform bathymetric chart of the oceans, thus utilizing the data of many governments; and it would seem to bode well for the contact of the new Bureau with oceanographers in general that the seat selected for it is Monaco.

From now onwards the principle is established that all information about the coasts and the oceans gathered by official departments is to become available to all other similar departments which adhere to the International Hydrographic Bureau, and the adherents are to have an opportunity for open discussion at a conference every fifth year.

The author of the idea was the late Joseph Renaud, Director of the French Hydrographic Service. At a preliminary conference held in London in 1919 a committee consisting of M. Renaud and the Hydrographers of Great Britain and the United States began its labors of organization, and within a year practically all the invited States had approved of their recommendations.

The main objects of the Bureau are to co-ordinate the efforts of the various Hydrographic Services with a view to rendering navigation easier and safer on all the seas, to obtain as much uniformity in hydrographic documents as possible, and to advance the theory and practice of hydrography. The Bureau has no authority over the national Hydrographic Offices; it is a consultative body. Its functions may be summarized as follows:

The maintenance of up-to-date collections of charts and other documents issued by the various Hydrographic and Meteorological Services, together with the preparation of a list of such hydrographic documents as are of historical interest, and their whereabouts.

Study and research upon all subjects which affect hydrography, including instruments and survey methods.

Publication of various lists such as those of geographical positions, and the distribution of information regarding new surveys, etc.

Advice, when asked for, which will aid governments in establishing Hydrographic Offices, or in developing those already established.

The Bureau has unfortunately been deprived, by his death, of the further services of M. Renaud on its Directing Board. This Board, elected for five years, consists of Vice-Admiral Sir John Parry (Great Britain), President, and representatives from the Netherlands and Norway. The address of the Bureau Hydrographique International is 3 rue du Port, Monaco, and the Secretary-General is Captain G. Spicer-Simson (*Geogr. Journ.*, April, 1922).

## Obituary

Thorvaldur Thoroddsen. The well-known Icelandic geographer and geologist, Thorvaldur Thoroddsen, died in Copenhagen on September 30, 1921, after an illness of several months. He was born in Iceland on June 6, 1855, and studied in the universities of Copenhagen and Leipzig. For many years he was teacher in the College of Reykjavik until 1899, when he moved to Copenhagen and devoted himself to research and writing. As a young student he accompanied in 1876 Professor Johnstrup on his expedition to investigate the Icelandic volcano Askja, and this directed Thoroddsen to what became the task of his life. He realized how imperfect was existing knowledge about the nature of his native land, and in 1881 he began exploring it; with public and private support he continued this exploration often under great difficulties almost every summer until 1898, having then visited all parts of the country. The results of these explorations he published from time to time in various Icelandic and foreign periodicals. In 1900 appeared his geological map of Iceland, a few years later his important descriptive work, "Island: Grundriss der Geographie und Geologie" (*Petermanns Mitt. Ergänzungsheft No. 152*, 1905, and *No. 153*, 1906). "An Account of the Physical Geography of Iceland with Special Reference to the Plant Life" appeared in 1914 as a part of "The Botany of Iceland." He was a prolific writer, and in Icelandic there are several large works from his pen, such as a history of Icelandic geography (in four volumes, the first two of which were translated into German); on earthquakes in Iceland; on the climate of Iceland during the last thousand years; an account of his explorations and travels (in four volumes); a comprehensive description of Iceland, which he left unfinished, four volumes having appeared at the time of his death; and many other smaller writings. His most important contributions to science were his writings on volcanism. When he began his explorations only about 30 volcanoes were known in Iceland, but he found there at least 130. No one had so varied and wide knowledge about his native land as Thoroddsen; he was a historian as well as naturalist. He was an attractive personality, a cultured and widely read man with many interests. In recognition of his work he received many honors. In 1894 the University of Copenhagen made him a doctor *honoris causa*, and in 1909 he was elected member of the Danish Royal Academy. In 1906 he received the Daly medal of the American Geographical Society and he also held gold medals from the geographical societies of Copenhagen and Paris and the Linné medal of Stockholm. He was honorary member of several scientific societies.

H. Hermannsson

# GEOGRAPHICAL REVIEWS

## Oceanic Cultures

A. C. Haddon. **Migrations of Cultures in British New Guinea.** Maps. *Journ. Royal Anthropol. Inst.*, Vol. 50, 1920, pp. 237–280. London.

A. C. Haddon. **Racial and Cultural Distributions in New Guinea.** Maps, bibliogr. *Geogr. Teacher*, No. 59, Vol. 12, 1921, Spring, pp. 15–19. London.

R. B. Dixon. **A New Theory of Polynesian Origins.** *Proc. Amer. Philos. Soc.*, Vol. 59, 1920, pp. 261–267. Philadelphia.

**"A New Theory of Polynesian Origins," by R. B. Dixon, Ph.D.: A Review.** *Journ. Polynesian Soc.*, Vol. 30, 1921, pp. 79–90. New Plymouth, N. Z.

T. R. St.-Johnston. **The Islanders of the Pacific, or the Children of the Sun.** 307 pp.; maps, ills., index. T. Fisher Unwin, Ltd., London, 1921. £1, 5s. 9 x 6 inches.

It is little wonder that with the Pacific so suddenly thrust into the foreground of international politics and diplomacy, the ethnological world of Europe, America, and Japan should be making a new effort to unravel some of the problems connected with its peoples. At the close of the late war the Government of Japan sent out an ethnological party to the islands north of the equator, and at this present moment a scientific expedition from America is working in the South Seas under the auspices of the Bishop Pauahi Museum of Honolulu. The publications listed at the head of this review are only a tithe of the literature on the subject that is constantly issuing from the printing presses of the different countries.

The island of New Guinea lies at the gateway of the Pacific, and it has experienced in consequence nearly all the cultural influences that have affected that region. The varieties in physical type of its inhabitants, the divergences in social organization, material culture, and language between even neighboring settlements, are amazing. But the confused mass of ethnographic data from the island is gradually being systematized through the labors of Dutch and German scientists in the west and north and of English in the south and east. The two articles by Professor Haddon outline the main racial and cultural distributions as far as they are known at present. The population is divided into three groups, partly on linguistic grounds, and partly on the basis of physical type. The earliest inhabitants were probably the pygmies, a Negrito people found in a relatively pure state only in the mountains of Netherlands New Guinea but discernible in a mixed form in many other parts of the island; nothing is known concerning their language. Next come the so-called Papuans proper, who greatly resemble the pygmies but are taller and have noses that are frequently curved. Their languages are all classed as Papuan, although it is very doubtful whether they form a single linguistic group. Finally, in the northeast and southeast, are the Papuo-Melanesians, indistinguishable from Papuans in many places as far as physical appearance is concerned, although in the southeast there is a tendency towards lighter skin color and less woolliness or frizziness of hair. The main reason for separating them from the Papuans is a linguistic one, all their dialects being varieties of Melanesian and hence belonging to the great Austronesian family of languages.

The Papuo-Melanesians were evidently the latest immigrants. Professor Haddon seems to consider that they reached New Guinea in at least two main migrations, each with its distinctive culture, but both from Melanesia. Friederici, on the other hand, holds that one migration came direct from Indonesia, passed along the north coast through Vitiaz Strait, and colonized the southeastern end of the island without going on to Melanesia proper. Important evidence on this point could probably be gained by an intensive study of the inhabitants of Rossel Island, the most easterly island in the group of archipelagoes that lie off the southeastern end of New Guinea. All the other islands in this region are Melanesian in language and culture, but the natives of Rossel Island speak a Papuan language; and their culture, what little is known of it, seems to be intermediate in character.

The similarity between the cultures of the north coast tribes and those of the Gulf of Papua on the south coast has been known for a long time, but Professor Haddon has

proved it to be much greater than was generally recognized. He ascribes it, not to intercourse and the spreading of culture elements from one tribe to another, but to a migration of peoples from the north coast over the interior range of mountains to the south. There must have been some very compelling motive for a migration over such difficult country, and one may suspect that it was not unconnected with the descent of Melanesians upon the north coast. But as long as our data remain so scanty it is rather fruitless to speculate on such a topic. Few of the tribes even in the coastal regions have been adequately studied, while of the interior we know very little. The distribution maps that Professor Haddon has published and the few generalizations that he ventures to base on them give the most accurate summary we can expect at present of the ethnography of the island.

The article of Dr. Dixon covers not only New Guinea but the whole of the Pacific. He has attempted to separate out the different strata that have gone to make up the population of this area by analyzing the prevailing physical types as shown in the cranial measurements recorded by different writers. Data even from this source are limited, and there is no means of correlating the specific features with stature, skin color, or the color and shape of the hair; these are limitations that Dr. Dixon himself frankly admits. But with the available material he has mapped out his area and drawn from the geographical distribution of his cranial types certain conclusions which are both novel and in some respects startling. It is true that they are given as tentative only; but the method employed is essentially sound, and it is to be hoped that his article will stimulate more researches along the same lines.

The conclusions he draws are as follows. The underlying stratum throughout the whole of the Pacific is the Negrito, the type of dwarfish, black-skinned woolly-haired native who can still be found in the Philippines, the Malay Peninsula, and, we may add, the interior of New Guinea, where a pygmy people, prophesied by Haddon, was discovered later by Wollaston. Overlying the Negritos is a stratum of Negroid peoples such as now form the bulk of the population of Melanesia and Australia; they absorbed the Negritos to such an extent that the earlier type survives east of New Guinea only in Kauai, the most northern island of the Hawaiian group, although derivative forms may be traced on the eastern and southern margins of the Pacific area, particularly in Easter Island, the Marquesas, and New Zealand. Nearly synchronizing in time with the Negroid invasion was a wave of Caucasic people, evidence for which is also found in Hawaii and New Zealand. Both the Negroid and Caucasic peoples were then pushed out to the margins of the area by a wave of Malayan or Mongoloid strain, which blended slightly with the earlier inhabitants and became the Polynesians now predominating throughout the northern, eastern, and southern portions of the Pacific.

The theory, as we have seen, is based purely on the distribution of cranial types and will probably need modification as more data accumulate. Several difficulties at once suggest themselves. The Negrito element is certainly present in New Guinea and almost as certainly in Melanesia, but for its diffusion throughout the Pacific there seems to be no evidence of any kind apart from cranial type. For the wide diffusion of the Negroids, on the other hand, there is abundant proof not only in present-day physical types but in archeological remains, as at Easter Island, and in the traditions of most of the island groups. Percy Smith accounts for it by the presence of Melanesians as serfs and crews in the ships of the Polynesians; but, unless it was afterwards swamped by a further wave of Polynesians who brought their wives with them and passed through Melanesia without amalgamating with the darker peoples, we should expect to find the Negroid element as pronounced in central Polynesia as on the outskirts. The diffusion of certain cultural traits supports the theory that the Negroids once covered the Pacific at least as far as Easter Island. Thus the chewing of lime and betel nut in the western Pacific and the similar chewing of coca and lime in South America almost certainly had a common origin. The Polynesians proper never adopted the custom, as far as we know; and it seems more reasonable to assume that it spread to South America from a Negroid population inhabiting the eastern Pacific than from mixed Polynesian and Negroid serfs who had probably ceased to practice it. But, while we may accept the theory of the priority of Melanesians to Polynesians in Oceania, the case for the earlier priority of Negritos is less clear. If Dr. Dixon's data are accurate it would seem rather that the first Negroids who reached the Pacific were mingled with Negritos; and the Negrito element, being twice submerged, is indistinguishable now except on the outskirts.

Another difficulty in Dr. Dixon's theory is the common origin he ascribes to the bulk of the inhabitants of Australia and Melanesia. Even physically there is a vast difference between the two peoples, the former being almost black with curly or merely wavy hair, while the latter are a dark chocolate only, with hair noted for its frizziness. There may be, of course, and probably is, a common strain in both; but as the evidence now stands Australia would seem to contain a very early Negroid stock differentiated from all others by straighter hair. It is worth noticing in this connection that while Australian languages have been divided into two groups, neither of them can as yet be affiliated with any other known language. It is true that certain culture elements are held in common by both Australians and Melanesians, such as the dual organization of society and totemism, but similar elements are found in North America as well. More evidence is required, therefore, before we can safely include Australia and Melanesia in the same Negroid group.

Dr. Dixon's Caucasic type, which he suggests appeared in company with the Negroid, is frankly a mystery. There can be no question here of the oft-attempted derivation of Polynesians from a Caucasic or white stock, for Dr. Dixon's type is distinguished from the brachycephalic Polynesian by its long-headedness. Nor can we correlate it with any definite culture; it will not fit in, for example, with Rivers's "kava" and "betel" immigrations, or with the two streams of migrants from Indonesia into Melanesia traced by Friederici. Perhaps the Bishop Pauahi Expedition may throw more light on this phase of Dr. Dixon's theory.

The Malayoid or Mongoloid origin ascribed to the last wave of immigrants into the Pacific, the Polynesians proper, is in line with all the latest evidence. The measurements of living Samoans made by Gifford and McKern in 1920 serve to confirm it. For Sullivan, in working up these measurements, concluded (1) that it was far more difficult to reconcile European racial origin for the Samoans and Polynesians in general, than to assume Mongoloid affinities and origins; and (2) that, considering the Samoan group as a unit, there is very little Melanesian blood in evidence. That Mongoloid, not Caucasic, is the predominant strain in their blood, is supported by the theory of Father Schmidt, now accepted by most linguists, that both the Melanesian and Polynesian dialects are to be affiliated with the great Mon-Khmer group of languages of Farther India and the Malay Peninsula. Oceanic traditions, so exhaustively recorded and analyzed by Percy Smith and his fellow workers, point undoubtedly to southeastern Asia as the original home of the Polynesians. These traditions give us not only the approximate dates of their voyages of discovery and colonization of the different archipelagoes in Oceania but even fix the date at which they left Indonesia; it can hardly have been earlier than the beginning of the Christian era and certainly no later than the end of the fourth century.

It is but a short step from the realm of legitimate theory to the region of pure speculation. Colonel St.-Johnston's book, we fear, falls largely in the latter sphere, although its compactness and broad handling of its subject and its numerous excellent illustrations will give it a wide appeal among the general public. The author is well acquainted with Fiji from his long residence there as a District Commissioner. By browsing through much of the literature relating to the other islands of the Pacific he has become familiar with many of the theories prevalent in England and New Zealand concerning the origins of its peoples. While trying to reconcile all these conflicting theories he gives special prominence to one of them—the supposed entrance into the Pacific, at a rather uncertain date, of a people who introduced the custom of building megalithic monuments associated with the worship of the sun. Here and there throughout his book are little Frazerian touches describing how cannibalism, taboo, and sun worship may have arisen, and how the last developed into fire worship, ancestor worship, and fertility worship, favorite subjects of investigation a quarter of a century ago but rather avoided now by cautious ethnologists, who feel more and more that long centuries and millennia lie at the back of the very simplest elements of culture, that customs and institutions change and undergo reinterpretation like other phenomena, and that it is almost as difficult to discover the real origins of religion and totems and clans as it is to discover the origins of fire or of the family unit. But Colonel St.-Johnston is writing frankly for the general public, who demand intelligible and convenient theories to explain these problems. More interesting are the pages of his book in which he attempts to work out his main theory—that the Pacific has been the home of three successive peoples, now blended in many places: (1) Negritos of the type that still remain in the Andaman and Philippine Islands to the west; (2) Melanesians, descendants of early Dravidians, a part of the "dark Caucasian"

division of mankind, driven some time after 2500 B.C. from India into Indonesia where they blended with "Armenoids" from western Asia and moved on into the Pacific, peopling most of the islands and probably reaching America; (3) Polynesians, "Aryan" seafarers from Mesopotamia and southwestern Asia, who came by sea to Java before 500 B.C., pushed eastwards not long after the beginning of the Christian era, drove out or exterminated the earlier Melanesian inhabitants in the eastern Pacific, and even roamed over a large part of America. The last-named are his sun worshipers *par excellence*, who have left their traces in megalithic monuments in all portions of the globe, in Mexico and Peru, the islands of the Pacific and Indonesia, western and northern Asia, North and South Africa, and western Europe. Myths and traditions, burial customs, insignia of royalty, cannibalistic rites, fire walking, sacrificial offerings, kava drinking, and linguistic data are invoked, one after the other, in support of the theory. The chapter on "Language and Place-Names" is characteristic of Colonel St.-Johnston's methods. He considers Polynesian as "virtually the extinct Turanian language." "Turanian is of the type known as agglutinative . . . [and] the general tendency is for the agglutinative type to change on further development into the inflectional type. Two well-known inflectional languages that succeeded the Turanian were the Semitic and the Aryan." "Egyptian, Assyrian, Arabic, Persian, Indian, and even Mongolian languages have all brought their quota to the ultimate result of 'Polynesian' as we know it." "Another word common to England, Greece, and Polynesia is sea-urchin, seen as ἐχῖνος (Greece) and ekina (New Zealand)."

The book as a whole makes very interesting reading, especially the little original anecdotes of native life in Fiji. It will do valuable work in drawing the public attention to the complexity of Oceanic cultures and to the vast historical problems that they involve; but the writer's arguments contain too many unproved hypotheses and too many false generalizations for his solutions to be accepted at their face value.

D. JENNESS

## ETHNOLOGY OF THE COPPER ESKIMO

D. JENNESS. **The Life of the Copper Eskimos.** 277 pp.; maps, diagrs., ills., bibliogr., index. (Report of the Canadian Arctic Expedition 1913–18, Vol. 12. Southern Party, 1913–16.) Dept. of the Naval Service, Ottawa, 1922. 9½ x 6½ inches.

This appears to be the first, or preliminary, report of the anthropological results of the Expedition and, according to the author's statement, is addressed to the general public, in contrast to future volumes upon music, language, material culture, etc. which will be of a more technical character. We are reminded at the outset that the misfortunes of the Expedition and the untimely death of M. Henri Beuchat disarranged the plans of the party, preventing the author from reaching his objective, the Copper Eskimos, until the autumn of 1914 where he, as the sole anthropological survivor in the Southern party, undertook to carry on alone all the phases of the investigation. With this task he occupied himself, as circumstances permitted, until July, 1916, something less than two years. In fact, the time of actual contact with the Eskimos was much less; thus the first Eskimos were met on November 19, and subsequently it was not possible to keep in constant contact with them. Nevertheless, owing to his experience elsewhere and his manifest genius for the work, the author seems to have gathered a large amount of data. His task, as he conceived it, was to follow the lead of Stefansson, the first technical observer of these Eskimos; for he states that "Mr. Stefansson obtained an astonishing amount of very valuable information in a comparatively short space of time, and while it was inevitable that a certain number of errors should have crept into his accounts, yet his works will always stand as the basis on which future investigators will have to build" (p. 11).

The subject matter of this preliminary report is, in the main, organized under such conventional topics as distribution and trade, houses, society, the food quest, marriage, birth, death, religion, and amusements. In addition, there are descriptive sections on the country and a chapter on psychology and morality.

As those familiar with the reports of the earlier Stefansson expeditions know, the home of the Copper Eskimos is along Coronation Gulf, on the north side in Victoria Island, as well as on the south side, on the Canadian shore, some 30° west of Hudson Bay. As during more than half the year the Gulf is frozen over, it presents no great barrier. One feature of the Copper Eskimo habitat should be noted, it lies across the great road of seasonal migration for the caribou; hence, so long as these herds survive, they will in season be accessible to these Eskimos. Between times, there are the immediate inland

waters for fishing and fowling and in winter the Gulf for sealing. It may be remarked that this is the locality chosen by the late H. P. Steensby as the most probable birthplace of Eskimo culture and, therefore, to be regarded as the environment most favorable to such a culture. Anyway, there is good reason to believe that the culture of these Eskimos is highly typical of the whole. Consequently any such contributions as the volume under consideration are doubly welcome, for already the culture of these people is losing its primitive character by the introduction of firearms, iron tools, and new methods of livelihood. Our author may thus be the last to come in contact with this original, but now passing, type of Eskimo culture (see also D. Jenness: The Cultural Transformation of the Copper Eskimo, *Geogr. Rev.*, Vol. 11, 1921, pp. 541–550). Yet we are warned on page 47 that later the author will bring forward proof that the Copper Eskimos reached the Coronation Gulf region but recently. The wisdom of withholding so important a matter is certainly questionable; the logical place for it is in the present volume, for upon this hinges the interpretation of the data presented.

Though, as the author states, material culture and technology are to be treated in a later volume, he gives us a long detailed account of houses and tents and another of food. These chapters leave little to be desired as to content. The varieties of shelter, both in summer and in winter, are given *in extenso*, and the range of food, methods of eating, etc., are portrayed. The lack of wood in their habitat dooms the Copper Eskimos to houses of snow and skin, while the fauna leaves them but three dependable staples, caribou, seal, and fish, which unfortunately have their seasons of accessibility. Hunting, sealing, and fishing are described to complete the narrative. A unique section, however, is that dealing with the winter and summer life of the group, or following the calendar around. While the northern Indians congregate in summer and scatter in winter, the reverse holds for the Copper Eskimos; for they live in large villages on the ice in midwinter, begin to scatter in the spring, and finally spread out inland for fishing and hunting, to come together again when the ice begins to form in September and October. The author followed one group through its round of life and gives in detail a diary account of the doings of his companions from April 14 to November 8, inclusive. During this interval the party crossed to Victoria Island and wandered about, east and west, over some 4° of longitude; but it is quite impossible to summarize further the discussions of social life, religion, etc., that follow, for the text deals with real events and individual happenings.

In the way of adverse criticism, it may be noted that the form of the work and the lack of topical headings, with some laxity of organization, will detract from the value of this volume as a work of reference. Fortunately, a topical index is provided, otherwise the reader would be compelled to scan numerous pages for the data desired.

Finally, the author and all those responsible for the Expedition and its results are to be congratulated upon this volume which, as supplementary to Stefansson's initial account, goes far to fill the gap in our knowledge between the Eskimos of the West and those of Hudson Bay. As this is the first of a series of five volumes, we may expect that the culture of the Copper Eskimo will become the best known of all.

CLARK WISSLER

## TRAVEL AND POLITICS IN EASTERN AFRICA

SIR ALFRED SHARPE. **The Backbone of Africa: A Record of Travel During the Great War, with Some Suggestions for Administrative Reform.** 232 pp.; maps, ills., index. H. F. & G. Witherby, London, 1921. 16s. 9 x 6 inches.

In this book, dealing with the highlands of eastern Africa, Sir Alfred Sharpe has given us a volume of unusual interest, largely political, partly a frank expression of vexed questions of policy, at times the experience of a traveler with an eye to the economic future, and again, merely that of the enthusiastic hunter of big game. Its author was administrative head of Nyasaland for many years and traveled extensively in that region and in Northern Rhodesia, the eastern Congo, Ruanda, Uganda, and Kenya Colony and is thus well qualified to speak on his subject.

The Kivu region of the eastern Congo apparently left the deepest impression upon him. Here is a country of unexcelled climate and of rich pastures of grassland where cattle do well and which is commercially almost untouched by the white man. In Nyasaland, where European settlement has progressed rapidly, coffee, formerly the most important European

crop, is giving way to cotton and tobacco. Not only do the white landlords grow American upland cotton, but by a co-operative scheme the natives also are growing cotton, which they sell to the Europeans at about one penny a pound (including seed). This greatly increases the total production. Fiber, chilies, and Ceará rubber are also produced, the latter at a cost of about three shillings and sixpence a pound. In Uganda, especially around Lake Kiogo, there is a great increase in cotton production, while both Uganda and Kenya are producing coffee, cotton, and sisal.

Manifestly, if produce is to be sold and shipped, rail lines must be extended. There are so many plans suggested in developing Africa's railroad system that it is almost confusing to consider them. Sir Alfred considers only those which may reasonably be regarded as probable within a few years. Nyasaland is already a productive country and needs access to a good harbor. To this end a rail line is being developed from Beira in Portuguese East Africa which will cross Zambezi near Chindio where it will join the Nyasaland railway, thus giving a continuous passage from Blantyre to Beira. This rail line may be extended to Fort Johnston and Nyasa and a projected line east to Fort Jamison in Northern Rhodesia. It is also probable that a railroad 230 miles long will replace the Stevenson road between Nyasa and Tanganyika. The Portuguese may build in from Pemba Bay to Nyasa at M'tengula. As a further development of the rail transport for the Nyasa lake region the author suggests a line from Morogoro or Kilossa on the Central Railway to the Langenberg district.

The rich cattle lands of Urundi and Ruanda and of the eastern Congo offer to the future the possibility of commercial exploitation. Several lines are projected to the country. One may run from the upper end of Tanganyika to Lake Kivu through the Rusizi valley, another may run from Bukoba on Victoria Nyanza to Kivu, and still another may follow the old German prospect and run from Tabora to some point in Ruanda (see map, p. 356 of this *Review*).

Great interest is shown in the Kilo-Moto gold mines of the northeastern Congo. These are unusually rich placer deposits which are easily worked by natives under Belgian direction, the profits going to the government. Three possible routes of communication to the Kilo-Moto region are mentioned—one by way of Stanleyville on the Congo, one leading north to Rejaf on the Nile, and one by an extension of the Uganda railway, which would bring Kilo within 28 days by rail and boat from Marseilles.

Sir Alfred is of the opinion that the phrase "Cape to Cairo Railway" (see *Geogr. Journ.*, Vol. 52, 1918, pp. 141–157) does not mean much, since most of the purposes of export are met by lines leading to the nearest seaboard, and the long central line cannot hope to compete with these. He mentions the possibility of extending the line from El Obeid to El Fasher, and possibly across to West Africa. Robert Williams, who has been so great a factor in railroad construction in South Africa and who is the successor to Rhodes in this respect, states (*African World*, April 8, 1922, pp. 338 and 392) that in about four years the Benguela railway will connect with the Belgian Congo railways and that during the past year an expedition has been at work to extend the Sudanese railway south to join the Uganda railway. Another suggested line would lead from El Obeid to Stanleyville. This would make possible the passage from Cape Town to Cairo by rail and steamer.

The position of the native under white domination is a matter that naturally comes up for discussion. When a primitive people first come under control of the white race they show no especial interest in over production and consequently offer the white man no chance of deriving profit from them. The first problem is, therefore, that of getting them to work. This is usually represented as being done in the interest of the black himself, but the profit so obviously accrues to the white man that his assigning it to altruistic reasons is probably only a clearer proof that he realizes the selfishness of his acts. The author, who was for years governor general of Nyasaland, states frankly that to enforce labor on a primitive race would not be tolerated by civilized man. He then points clearly the way by which this enforced labor is accomplished, presumably without offending the finer sensibilities of the same civilized man. First, a head tax (or a hut tax) is placed on the native. To earn this money he must work for the white man. In Nyasaland the hut tax, which is relatively low, amounts to eight shillings a year and is reduced to four if the hut owner works as a paid hand for a European within the protectorate for one month during the year. The white man thus secures labor which can hardly be called voluntary, and the government likewise is repaid for any service it may have rendered. Taxes are often high, and it is this method that produces the bulk of native labor. There are other methods employed. The native is taught or forced by custom or regulation to wear clothes. These he must buy.

His appetite for new foods and new drinks is developed. It is not long before he is entirely removed from the social life he previously enjoyed, from the domestic activities of his race, such as preparing new land, building new houses, hunting, dancing, and fighting, and is forced into a life in which he devotes much of his time to serving the white man. These are the first steps in his civilization.

The position of the missionary is a difficult one. Often without so intending he becomes a part of the system outlined above. The better class of missionary, however, realizes that the tribe has been adapted to its surroundings by hundreds of years of trial and error and that suddenly to break down their social system is a very dangerous thing. Such missionaries, building gradually on the substantial foundation of right and wrong which the tribe has developed, are slow to introduce clothing, new customs in marriage, or other changes which too often lower the moral tone of the native and give him nothing really substantial in its place. Sir Alfred frankly states that civilization and morality are inversely proportional in the natives of East Africa.

Disrespect of the white man for the social system established by the black is unfortunately characteristic of too large a number of administrators. Temple in "Native Races and Their Rulers" (Cape Town, 1918) emphasizes the importance of maintaining the tribal organization and supporting the native rulers. In Urundi and Ruanda the Belgian officials are supporting the native rulers and are not interfering with the native customs and practices any more than seems justifiable and for the interest of the natives themselves. To enter a country and break down the long established social order seems hardly justifiable. The Watusi are a superior race (see the reviewer's article on Urundi elsewhere in this *Review*). Sir Alfred, however, holds them in contempt and suggests that their cattle and lands be taken from them and distributed to the Wahutu, or subservient, race. While many would agree that the subservient Wahutu should force this readjustment, just as certain forces in England are interested in seeing the industrial and landed aristocracy forced from their present position of security, it seems strange that the author should advocate an outside power's forcing this change on the people of Urundi and Ruanda. The Watusi, who are regarded by most travelers as a proud, haughty, and superior race, are by no means effeminate. If they were, the Wahutu, who outnumber them ten to one, would soon displace them. Administrative officers too often stamp out the strong, independent groups and favor races which are far inferior and which, because of their docility and weakness, are much more amenable to white domination.

Another important problem in connection with native labor is the degree to which natives should be moved from place to place, or even leave the country for employment in a distant protectorate. Europeans are opposed to the migration of native labor from the protectorate in which they live to adjacent countries; but where labor is deficient they are equally in favor of importations. Such migrations, or even the movements of large bodies of laborers within the colony, rapidly break down the native social system. The amount of labor available in Nyasaland is estimated by the author as 200,000 blacks who are willing to work a few months during the year for the 1,000 whites.

Land policy is as important as labor policy. In most tribes the chief holds all the land and allots this to his people. He can dispose of it to the whites. In any case the land gradually passes from the natives to the whites, unless the government adopts strenuous preventive measures.

In developing the agricultural production of the natives it is important to protect them from fluctuating prices. The author suggests that a bonus may be returned to the native during years of unusually good market and in this way he may not become discouraged when low prices follow good prices.

The author suggests sweeping changes in the administration of East Africa. He would shift responsibility from the central Colonial Office to the colonies themselves, thus insuring more intelligent management. In this way the Crown Colony—a local benevolent autocracy —would give way to local self-government as the number of Europeans increased. As long as the executive is purely official and the legislative body is appointed by the home government, the colonists have no real status or influence; and the fact that crown land can only be leased and cannot be acquired does not encourage settlement or permanent development.

He would unite under one administrative head all British territory south of the Anglo-Egyptian Sudan and north of the Zambezi and establish the seat of government at Zanzibar. This colony would be known as the "Colony of British East Africa" and would include colonies, protectorates, and mandated territories alike. It would be composed of three

minor divisions as follows: (1) Nyasaland, Northern Rhodesia, and portions of Tanganyika Territory, with headquarters at Zomba in Nyasaland; (2) Uganda, Kenya Colony, and part of Tanganyika Territory, with headquarters at Nairobi; (3) Zanzibar, Pemba, Mafia, and the remaining part of Tanganyika Territory, with headquarters at Zanzibar. The new southern boundary of Uganda would run west from Emin Pasha Bay on Lake Victoria to the Belgian boundary; the southern boundary of Kenya Colony would run from Speke Gulf or Lake Victoria to the coast south of Pangani River. Nyasaland would be increased by the block lying south of the eighth parallel and west of longitude 34° 30′ E.

Thus there would be set up in East Africa a great colony. Its relations to South Africa would be interesting. It is not unlikely that Southern Rhodesia and possibly Northern Rhodesia will soon become part of the Union of South Africa. Tanganyika Territory was eagerly conquered by South Africans and, had it not been for restrictive administration, would probably have been rapidly settled by them. There is plainly a gradual northward migration which will possibly result in the union of all the South and East African British domain under a single government. While the suggestions advanced in this book may, if followed out, tend to slow down this development at first, they may in the end hasten the final accomplishment of such a union. The wealth of this great block of land and the variety of its natural resources would seem to point clearly to the development here of a great nation at no very distant date.

H. L. SHANTZ

## LIFE AND EXPLORATION IN AFRICA

ERNEST BAKER. **The Life and Explorations of Frederick Stanley Arnot.** 334 pp.; map, ills., index. E. P. Dutton & Co., New York, 1920. $5. 8½ x 6 inches.

RENÉ BAZIN. **Charles de Foucauld, explorateur du Maroc, ermite au Sahara.** 479 pp.; map, ills., bibliogr. Plon-Nourrit & Co., Paris, 1921. 10 frs. 8 x 5 inches.

EDOUARD FAVRE. **La vie d'un missionnaire français, François Coillard, 1834–1904.** viii and 320 pp.; map, ills. Société des Missions Évangéliques, Paris, 1922. 10 x 6½ inches.

H. RAYNE. **Sun, Sand, and Somals: Leaves from the Note-Book of a District Commissioner in British Somaliland.** 223 pp.; ills. H. F. & G. Witherby, London, 1921. 12s., 6d. 9 x 6 inches.

MANFRED NATHAN. **The South African Commonwealth: Constitution, Problems, Social Conditions.** xi and 483 pp.; index. The Specialty Press of South Africa, Ltd., Johannesburg and Cape Town, 1919. 30s. 8½ x 5½ inches.

By their wide diversity of subject matter these five books of life and exploration give an interesting and comprehensive picture of the great variety of topography, climate, and life embraced within the African continent. The viewpoint of each author is the intimate, appreciative attitude of one who knows first-hand whereof he speaks. Each in his own way tells the story of the reaction of Africa to foreign invasion, whether it be of the French in Morocco, the British and Dutch in South Africa, the Arab and British on the Gulf of Aden, or the missionary, Catholic or Protestant, in the heart of the continent.

Mr. Baker, in "The Life and Explorations of Frederick Stanley Arnot," has really acted only as the editor of Arnot's own diary and letters, supplementing them with a bit of biography and filling in the gaps from his own knowledge. Arnot took his early inspiration for missionary work in Africa from none other than Livingstone himself. Refusing to ally himself with any of the Missionary Boards working in Africa, he made his first trip to that continent as a free-lance missionary in 1881, landing at Cape Town, and began his journey at Durban, in Natal, with the intention of following the Zambesi to its source where he expected to find a mountainous, healthy country in which to establish a missionary center. Much of the ground covered on this first trip had been previously traversed by Livingstone, who was still remembered by many of the natives. Arnot found the location he sought in Garenganze in northern Rhodesia. Of great interest are his explorations in the region Livingstone called the "Great Sponge of Central Africa," in the Lovale and Lunda country around Lake Dilolo, where within an hour's journey of one another he found streams running in nearly all the directions of the compass. Arnot made nine journeys in all to Africa during a period of thirty-three years and, in addition, a trip to British Guiana. The results of his endeavors are the establishment in the neighborhood of the

Central Plateau of Africa, of sixty-one missionaries in sixteen stations in five mission fields.

M. Bazin, also, has resorted extensively to the writings and letters of Charles de Foucauld, whose life as an explorer in Morocco and a Trappist hermit in the Sahara is the subject of his book. In fact the chapter entitled "L'Explorateur" is largely a summary of De Foucauld's own book, "Reconnaissance au Maroc." Foucauld, an Alsatian by birth and of a line of French nobility noted for centuries for devotion to Church and country, had his interest in Africa first aroused when he was sent to Algeria as a lieutenant in 1880. Dismissed from the army on account of a scandal of which he was the central figure, he returned to France but came back again to Algeria to take part against the revolution in South Oran in 1881. Morocco, because of its mystery and reputed impenetrability, attracted him as the proper field for the sacrifice which he felt called upon to make to expiate his wrong against his country. Disguised as a Jewish rabbi, since all but Jews and Moslems were *personae non gratae* in Morocco, accompanied by a Jewish rabbi and equipped with sextant and chronometer, he entered the country by way of Tangier, June 21, 1883. His route was by way of Fez across both the greater and lesser ranges of the Atlas and back to Mogador on the coast. On the return trip he again crossed the Atlas Mountains and followed their eastern slope to the Algerian frontier. The remainder of the book is devoted to the conversion and ordination of De Foucauld as a Trappist monk and his service as a hermit missionary in the Sahara.

Edouard Favre, in his preface, writes, "Nous avons laissé parler Coillard," and his book, like the two preceding, is very largely autobiography. François Coillard, a native of the province of Berry in central France and of Huguenot ancestry, spent most of the years of his missionary work in Africa from 1857 to 1904 in the semi-independent native states of Basutoland, between Natal and the Orange Free State, and Barotseland, now included in Northwest Rhodesia. Neither of these states had been reached by the *Pax Britannica* at the time of Coillard's arrival. The story of his work is that of patient endeavor for peace and reconciliation between natives and whites, and to it was due in large measure the ease with which British control was extended to the territory within which he had established his missions.

Mr. Rayne pictures with delightful humor his life as a British District Commissioner at Zeila, a port on the coast of British Somaliland which had passed through the vicissitudes of Arab and Egyptian occupation and exploitation before the advent of the British. Cattle raising is practically the only industry of Somaliland. With the proceeds the Somal buys from all parts of the world, the commodities reaching him mostly through Aden, the great clearing house of the East. Pearl fishing forms a minor industry. The Somal looks upon the British Commissioner as appointed for his particular use and proceeds to harass him, in season and out, with every imaginable grievance, trivial or otherwise. Hindu, Parsi, Mohammedan, Jew, and Christian live side by side in the commissioner's domain. His is the task of seeing that their relations bear somewhat the semblance of peace. Illuminating are the chapters on the Great War as it affected Somaliland, and of particular interest is the fact that the book closes with an account of the successful operations against Hassan Abdullah, the Mad Mullah.

Manfred Nathan, who is a member of the Transvaal Provincial Council, has made his book very much of a compendium of knowledge of South African life and affairs—racial, social, political, economic, educational. Some two hundred pages are devoted to a discussion of the origin, constitution, and political organization of the Commonwealth. The discussion is unusually good reading and is a pleasant departure from the customary lifeless method of presenting such information. The native problem, labor problems, the treatment of Asiatics, the industries, finances, education are treated in sympathetic fashion. Literature and science and their status in the Commonwealth are given separate chapters. The volume closes with a tribute to Louis Botha who died while the preceding chapters were in the press.

## Irrigation and Cultivation in the Senegal Basin

Yves Henry. **Irrigations et cultures irriguées en Afrique tropicale.** v and 296 pp.; maps, diagrs., ills. Émile Larose, Paris, 1918. 12 frs. 10 x 6½ inches.

The report which M. Henry has published with the collaboration of M. J. Lemmet deals chiefly with the possibilities of agricultural production in the valley and delta of the

Senegal River in French West Africa. From the spirited preface by M. E. Tisserand to the closing paragraph the report breathes a strong note of optimism, and frequent comparisons are made between the valley of the Senegal and that of the Nile.

Irrigation in the region of the Senegal is largely a matter of the future. At present the production of rice and sorghum, the chief food crops, is scarcely sufficient to support the sparse native population of some 200,000.

The Senegal, a river nearly 1,000 miles long, rises in a range of low mountains southwest of Dakar, flowing thence northwest and west into the ocean at St. Louis. The Niger, which has its source on the southern slope of the same range, flows a long way eastward before turning south and west. The Senegal is a sluggish stream when not in flood, its mean low-water gradient for nearly 600 miles above the mouth being about 2 inches per mile. Thus it is salty during low stage for 100 miles up stream.

The irrigable lands are composed of a blanket of silt deposited from the flood waters and of low relief. Like the valley of the Nile this silt blanket is underlain by ground water when not submerged. Much of the soil, particularly in the lower delta, is heavily charged with salt and when dry is often hard and slowly permeable to water.

M. Henry has brought together in his report a valuable collection of facts concerning the character of the soil, and the period and height of the flood discharge of the river. It is to be regretted that he has not included data from which the volume of discharge could be computed as well as facts concerning the salt content and the silt load of the stream.

The data on rainfall are comprehensive and cover a long period, but temperature data are wanting. For those who seek to support the hypothesis that deforestation causes decreased rainfall this report will be a welcome contribution.

The present agriculture of the region is described concisely, and the essentials for future development are boldly outlined. Detailed plans are suggested for control measures by which certain areas of the delta could be utilized more effectively, particularly the basin of the Lac de Guier, a basin tributary to the river about one hundred miles above its mouth.

The essential features of the proposed development are to prevent further salting of this basin by sea water and to regulate access of river flood water. The flood period extends from August to November. For the future the agricultural industries most emphasized are the production of cotton and dâ (*Hibiscus cannabinus* L.). The latter plant, which yields a soft fiberlike jute, is now produced by the Senegalese chiefly for local use. The present account of the plant and its production by the natives is a valuable contribution to the literature of fiber plants.

C. S. SCOFIELD

### TROPICAL FORESTS AND THEIR RESOURCES IN FRENCH COLONIES

A. BERTIN. Vol. 1. **Les bois de la Côte d'Ivoire.** 176 pp.; map, ills.; Vol. 2, **Les bois du Gabon.** 304 pp.; map, ills.; Vol. 3, **La question forestière coloniale.** xx and 833 pp.; maps, diagrs., ills.; Vol. 4, **Les bois du Cameroun.** 312 pp.; maps, diagrs., ills.; Vol. 5, **Les bois de la guyane française et du Brésil.** vi and 318 pp.; map, diagrs., ills. Mission d'Études forestières envoyée dans les colonies françaises par les ministères de la guerre, de l'armement et des colonies. Émil Larose, Paris, 1918–1920. 10 x 6½ inches.

This work describes the results of an official investigation of the forest resources of certain of the French colonies. Four of the volumes are devoted to detailed accounts of the economically important trees of the Ivory Coast (Vol. 1), Gabon (Vol. 2), Cameroons (Vol. 4), and French Guiana (Vol. 5), the last volume containing also an appendix on the timbers of Brazil. Volume 3, entitled "The colonial forestry problem" (La question forestière coloniale) is of more general interest both from the economic and from the phytogeographical point of view. The first part of this volume discusses the forestry situation in France, especially as affected by the war, and the necessity of drawing upon the colonial forests to supplement the home-grown supply of timber.

The second part of Volume 3 deals with the tropical forests of French West Africa, taking up in succession the Ivory Coast, Gabon, and Cameroons and describing briefly the physical geography of the forested regions, geology, human population, labor available for forest work, administrative organization of the colony, and means of transportation. There follows

an account of the general aspect of the equatorial African forest, a technical description of the timber resources, and a discussion of the botanical relationships of the trees.

Part 3 is devoted to methods of exploitation, and Part 4 to the sylviculture and management of the colonial forests. In Part 5 the technological classification of colonial timbers is treated, and Part 6 presents the conclusions of the mission regarding the utilization of the colonial forests.

It will be inferred from the foregoing abstract of its contents that this book is primarily of interest to foresters and persons having a manufacturing or commercial interest in tropical forest products. This follows from the definitely economic object of the mission and the circumstances under which it was organized. Professional geographers will turn to other sources for information concerning these colonies, although the student of plant geography will find in the second part of Volume 3 data on the botanical composition of the forests of tropical West Africa.

T. H. KEARNEY

## THE COAST AND ISLANDS OF FORMER GERMAN EAST AFRICA

EMIL WERTH. **Das Deutsch-Ostafrikanische Küstenland und die vorgelagerten Inseln.** Vol. 1, xvi and 334 pp.; map, diagrs., ills., bibliogr.; Vol. 2, vii and 265 pp.; maps, ills., index. Dietrich Reimer (Ernst Vohsen), Berlin, 1915. 10 x 7 inches.

This valuable work, describing the coast of the late German East Africa with its length of nearly 500 miles and its three large offshore islands, is based on the author's own observations, which continued over a number of years, and is extended by selections from studies of others. One of the chapters is analyzed below. The half-tone plates are good as a rule; the text figures are mediocre or poor; a bibliography of some thirty titles, some of them rather irrelevant, is given near the beginning of the first volume; the index at the end of the second is exceptionally full. There are no page headings, and the modern style of Roman type from which the book is printed is unattractive. The accompanying maps are of high value. Two are on a scale of 1:500,000, with flowing 50-meter contours, one of these showing the geology in nine colors; the other, in six colors, shows the distribution of vegetation, which seems to be closely related to the geology. A third map, on a scale of 1:2,000,000, exhibits the distribution of native culture. The plan of treatment is as follows. The first volume is occupied with a systematic account of various topics beginning with the near-shore sea (12 pp.); then come the structure and form of the coastal belt, from 20 to 40 miles wide, and of the large islands of Pemba, Zanzibar, and Mafia (88 pp.); next the climate (37 pp.), flora (57 pp.), and fauna (39 pp.); and finally the native tribes (152 pp.) and products and trade (75 pp.). The second volume is occupied with descriptions of six physiographic districts and their subdivisions, in which the topics that were separately treated in the first volume are presented in their natural relations; but the enchainment of the different topics is not brought out here so emphatically as one might wish.

The author shows himself to be broadly familiar with many subjects and sets forth much information in technical form that must be interesting to specialists in various sciences; but if the other chapters are not handled more skillfully than the chapter on geological structure and topographic form, here reviewed in some detail, they will be disappointing, even if instructive, to their readers. That chapter attempts to give a genetic account of the land forms, but the attempt is not altogether successful because the reader has to plow through too much explanatory argument before he reaches the things explained; and the plowing is sometimes difficult by reason of the involved construction of subordinate clauses. In some respects the sequence of treatment is unsatisfactory: for example, before the general features of structure and form are presented, the displacement of certain supposed fault blocks is described on a purely topographic basis but with no mention of post-faulting erosion; the reader can form no independent judgment here until after he has read later pages, and not easily then. The manner of treatment also is unsatisfactory in several sections because it does not clearly enough recognize that every structural mass has a changing surface form and that the reader cannot acquire an understanding of the districts concerned unless the present phase of changing surface form, as well as the more constant underground structure of each mass, is explicitly stated. Sometimes important details concerning structure are wanting, as in an account of the backland, where the occurrence of Jurassic and Cretaceous formations is noted but without indication of the thickness or attitude of their strata.

An overeasy acceptance of hypothetical displacements, above implied, is again seen in a brief account of coastal trends, which are ascribed in part to faulting; though it may well be believed that a true-scale section would show moderate flexures to be sufficient. Unfortunately, few sections are given, those few are grossly exaggerated vertically, and only one of them indicates underground structure; the others are drawn in solid black. Some of these, which by an entirely permissible reduction might be shortened to the breadth of a page so as to stand in proper attitude, have to be turned lengthwise along the page side, as a result of which their locality names are actually printed upside-down! The lack of carefully drawn structural sections seriously delays the understanding of the text; but the following physiographic relations appear to be indicated.

A hilly or mountainous backland, composed of gneiss, slates, and other rocks, and here and there reaching altitudes of from 600 to 1,000 meters at a distance of 20 or 30 miles from the sea, is unconformably blanketed in its lower areas with a heavy body of strata, sandy inland where their altitude is 200 or 300 meters and declining toward the coast where they become in part calcareous. Their surface is submaturely dissected by branching valleys, and the valleys are occupied up to 50 or 100 meters by a later series of sandy and loamy deposits which become confluent near the shore where they constitute a young coastal plain that is margined along the more advanced parts of the coast by a raised and clift coral reef 25 meters in altitude. A level limestone bench extends inland from the raised reef for an unspecified but apparently moderate distance and ends at an abrupt step which rises some 20 or 30 meters to the main area of the plain. The step and the bench in front of it are ascribed to former marine abrasion and correspond to similar features along the advanced shore of today. The inland branches of the coastal plain, which occupy the valleys of the uplands as above stated, are themselves as well as the forward part of the plain trenched by younger and narrower valleys, which are floored with flood plains, good for cotton culture, all the way to their mouths where the margin of the plain, retreating in two long bights, is cut back in sloping bluffs and fronted by shallow water; but where the margin of the plain advances in clift-reef headlands toward deep water between the two long, shallow bights, the valleys are entered by narrow salt-water embayments, which serve as excellent harbors. Beneath the clift-reef headlands of the advanced coast the deep-water shore is bordered by a well developed fringing reef, from half a mile to a mile wide; the shallow-water shores of the bights and the embayments are often bordered by mangrove swamps.

The coastal region, therefore, exhibits the records of three emergences and of as many submergences; the last submergence is thought, on rather insufficient grounds, to be still in progress. The elevated reef is one of the records of the second submergence; the sea-level fringing reef of the third. One of these widespread movements, perhaps the third one which is recorded by the emergence of the advanced headlands, seems to be responsible also for a down-warping of the coast in the two long shallow bights just mentioned. The longer bight is in the northern half of the colony and has a chord length of 150 miles; it is occupied near its middle by the 50-by-20-mile island of Zanzibar, which consists of mainland strata in its western half and of uplifted reef limestones in its eastern half and which shows along its eastern side two-level abrasional features like those of the advanced mainland coast. The second bight is in the southern part of the coast and has a chord length of 120 miles; it is occupied near its middle by the 30-by-10-mile island of Mafia, which is rimmed on its outer side by a much narrower elevated reef than that of Zanzibar. Behind this island the bight is narrowed and shoaled by the advancing delta of the Rufiji, one of the largest rivers of the region; its numerous distributaries have lengths up to 30 miles, and the delta has a still longer sea front. Both bights are beset by many reef patches with occasional islets.

The advanced clift-reef coast occupies three stretches, outside of which a rapid descent is made to deep water. The northern stretch, continued from British East Africa, is 70 miles in length and is partly fronted by a discontinuous barrier reef, offshore from which lies the 40-by-20-mile island of Pemba, with an outer border of raised reef in simple outline and a minutely embayed inner border; between the island and the continent is a reef-free, deep-water passage, 30 miles in width. As Pemba, like Zanzibar, contains some mainland strata back of its elevated reef, the deep-water passage may be plausibly ascribed to down-flexing or down-faulting. Another stretch of advanced coast, 140 miles in length, lies in the south and continues into Portuguese East Africa; several of its embayments near the German boundary are associated with sharp inturns of the 200-meter submarine contour; close to the boundary the Rovuma, about as large a river as the Rufiji, still has an estuarine mouth. The third advanced coastal stretch separates the two bights and is only 30 miles in

length; near its northern end Dar-es-Salaam, the chief port of the coast, lies on a fine harbor embayment; the town of Zanzibar, not far away to the north, has a reef-enclosed harbor on the western side of its island.

The fivefold division of the coast, just described, is the most profitable physiographic lesson of Werth's book. It is given belated statement in the first part of the second volume. The above explanation of it by down-warping in association with the emergence of the elevated reef, as well as the changes of level inferred from the sandy and loamy deposits which occupy the valleys of the uplands and which are themselves trenched by narrower and partly embayed valleys, are based more on the geological map than on the text; but the map indicates them so clearly that the absence or obscurity of text statements concerning them is not easily understood. On the other hand, a redundant treatment of the abrasional features along the advanced coast is also difficult to understand; they are described first under "Küstenterrassen" on pages 22 to 24 and again under "Strandterrassen" on pages 49 to 51. One bite at that sort of a cherry should suffice. But there is, without question, a large body of physiographic information contained in the two volumes; and if the other chapters are as richly stored as the one here reviewed they are well worth working.

The book appears to have been prepared about the time the World War began and was published during its progress. It is dedicated to those who had already lost their lives in defending German possessions in East Africa. The coastal belt was selected for description because of its great importance in the further development of the colony. The many pages must, therefore, be sad reading to German readers under present conditions; but they must be of high value to the mandatary in whose charge the colony has been placed.

**W. M. Davis**

## Dunes and Dune Formation

W. Behrmann. **Borkum: Strand- und Dünenstudien.** 40 pp.; map, ills. *Meereskunde No. 153* (= Vol. 13, 1919, No. 9). Berlin.

Borkum, a well known bathing resort, situated at the mouth of the Ems, nine miles from the Dutch coast and between the channels called the Oster Ems and Wester Ems, is the westernmost of the East Frisian Islands. The island has grown together from two islands, which are even now so clearly indicated that they bear the distinctive names of Eastland and Westland. The small Eastland lies north of the larger Westland and is not so greatly exposed to the winds and waves as the latter. The islands were separated from each other from time to time up to 1863. Since then they have been joined by a dike, and the dunes on the north have been made artificially and ingeniously for the reinforcement of this dike. At some time sand comes to the island from all sides except the east, where there is a sand-clay flat. The waves and the tides tend to beat and to scour material from the west end and to drive it toward or to this sand-clay flat. But there are high dunes on the west and also a beach wall almost four kilometers long which protects the land from the violent beating of the waves. Before this wall was built the breakers had already reached the dunes; and there is a steady westward movement of the sands along shore which has formed and maintains the "Hohe Hörn." This movement of the sand of Borkum is like that of all the Frisian Islands, to the east. The Eastland, however, is not so strongly swept and scoured by the winds, waves, and tides as the Westland. The sand level on the North Strand is wonderfully maintained through the protective effect of the great horseshoe-shaped dune which covers a large part of Eastland.

The author discusses in detail the formation of rill- and ripple-marks on the beach, as well as the deeper channels that occur in front of the breakers; and he describes the occurrence of beach potholes, made by the fall of the stronger breakers, and the formation and breaching of beach walls. The incoming waves and tides normally bring in much more material to the shore than is carried away by the ebb, and in this way a beach wall 80 to 100 meters broad and 1½ meters high has been built up between the beach flats and the sea. The beach flats are growing in the east and breaking down in the west. One may observe on a portion of Borkum the base level due to deflation, and every phase of the work of wind and wave is here observed and described.

"The side on which the wind allows plants to grow promotes upbuilding and encourages animal and human life. The fowl world of the inner side is entirely different from that on

the side exposed to the open sea. In the meadows struts the plover, the lapwing cries, and the crested lark rejoices; the beach bird shows himself only on stormy days, and in the protection of the dune. . . . The inhabitants use driftwood for fuel and building. Close by or between the dunes in the vicinity of the sea lie the little houses of the fishermen." The paper is a study of shore-line processes in relation to biogeography.

COLLIER COBB

ÉDOUARD HARLE AND JACQUES HARLÉ. **Memoir sur les dunes de Gascogne, avec observations sur la formation des dunes.** Extrait du *Bulletin de la Section de Géographie, 1919*, pp. 145. Paris, 1920.

The senior author of this interesting paper has previously published nine papers on different phases of the geology or geography of Gascony, one of which, "La fixation des dunes de Gascogne," was noticed in the *Geographical Review* for November, 1916. The two authors, father and son, have previously published, in collaboration, "Les dunes continentales des landes de Gascogne" and "Les dunes maritimes de la côte de Gascogne."

The dunes of Gascony, those of the interior as well as those that border the ocean, are very numerous, and those along the coast are the most considerable in Europe. Save for some very rare exceptions, those next the ocean are all covered with forests which are completely fixed. One rarely sees these dunes actually move, and many of the authors' conclusions are therefore deductions drawn from what has been told them about the now immovable dunes. The studies in each case deal with observations that have actually been made by someone up to this time. In certain cases the authors give no explanations of the observed phenomena, and in others they express doubt as to the explanations that they do give. The hope is expressed that even if what is set forth is incomplete and lacking in clearness, it will serve "to provoke someone to more careful study."

The account is illustrated with numerous plans and sketches which make clear the authors' explanations and give one an excellent idea of the country.

The paper then proceeds to a geological description of the country, which much resembles our own Atlantic coastal plain. The origin of the sands of the *landes*, that is their source and manner of transportation, is very obscure; but the author is inclined to accept the view expressed by Glayac that the sands have been brought from the land by the rivers, which have wandered much in their courses over the plain, and have been thrown up from the sea by the waves and driven inward by the winds. He objects to this explanation, however, on the ground that the material is very fine, and he would expect the river to bring down stones of considerable size, and the waves of the sea to throw up something of the same sort. The Garonne and Adour actually do transport fair-sized stones, and the sea is now actually depositing stones of some size on the borders of the *landes*.

An excellent and somewhat detailed description of the surface of the district is given, with some account of the agglomerated sand, known locally as *alios*, a hardpan which exerts a marked influence on the drainage and water table of the district.

Unlike previous studies of the region, this paper treats not only of the maritime dunes, but of the continental dunes as well, dividing these latter into dunes of the plateaus and dunes of the valleys. The authors here present a most interesting discussion of the origin of the parabolic dunes, where the wind has hollowed out the concave side. They have moved in a direction exactly opposite to that of the wind, which has formed and is now driving forward the *medanos* or *barchanes* in our own interior, or the whale heads on Currituck. The authors show one such form (termed *caoudeyre*) from the commune of Pissos, in which the hollowing is done by the wind moving in the direction of the horns of the crescent. These parabolic dunes owe their form to the erosive action of the wind, and in this they differ essentially from *barchanes*, which are due to constructive action, and these latter are evidently unknown to our authors in their district.

The *étangs*, lakes formed by dune action hindering drainage, are described, and the later formation of dunes on the shores of these lakes is indicated.

The sands composing the dunes, the differences between the ancient and the modern dunes, and the changes in the forms of the modern dunes produced by fixation, are all considered with much care.

The movement of dunes in waves, a phenomenon well-marked on our own Atlantic coast, is here noted, and the last section of the brochure is devoted to a discussion of the theory of such movements.

The bibliography is good but needs some additions. A detailed index would add to the usefulness of the paper. This paper, together with the account of the Borkum dunes, may well be taken as a model for future studies of dune areas.

COLLIER COBB

## A TEXTBOOK OF SEISMOLOGY

CHARLES DAVISON. **A Manual of Seismology.** xi and 256 pp.; maps, diagrs., ills., index. (Cambridge Geological Ser.) The University Press, Cambridge, 1921. 8½ x 6 inches.

Dr. Davison's contributions to the study of earthquakes are well known, and we welcome this volume from him. His "aim has been to give an outline of our present knowledge" of the subject; and this he has accomplished very well. He has given clear accounts of the principle of seismographs, of the nature of earthquake motion, of the propagation of the disturbance, of the geographical distribution of earthquakes—in short, of earthquake phenomena in general. Students of seismology will miss a discussion of the underlying principles of the subject and of its many still unsettled problems; but the length of the book and the general purpose of the series to which it belongs make this impossible. A few ideas are expressed with which the reviewer does not agree; for instance, Davison's conceptions of twin earthquakes. He supposes two fractures of the rock, at points not far apart, to take place within an interval of time so short that the second fracture could not be influenced by the vibrations from the first. Much stronger evidence than we have is necessary to establish so improbable a coincidence. In common with some other seismologists he thinks the buckling of railroad lines in Baluchistan at the time of the earthquake in 1892 indicated a compression of the earth's crust; whereas it was shown in the report of the California earthquake of 1906 that the movement on the fault caused just such an apparent compression without any reduction of the area of the region. Davison regards the first appearance of seismic sea waves at the shore as a depression of the water; this is certainly very general, but there are many instances where the elevation of the water occurs first. The destructive effects of earthquakes on houses and other structures are not treated, probably for lack of space and because these effects may be considered as belonging to applied seismology rather than to the pure science itself.

HARRY FIELDING REID

## A NEW ESTIMATE OF OCEAN DEPTHS

ERWIN KOSSINNA. **Die Tiefen des Weltmeeres.** 70 pp.; diagrs. *Veroffentl. des Inst. für Meereskunde*, N. F., A. (Geographisch-naturwissenschaftliche Reihe), Heft 9. E. S. Mittler & Son, Berlin, 1921. 10½ x 7 inches.

This is the latest of the many attempts to estimate the mean depth of the ocean. There are no new methods devised, but the work has evidently been very painstaking, and the results are probably very near the truth. Groll's equivalent-area maps of the oceans, corrected by additional observations made since they appeared, are the basis of the work. The method used was to print Groll's bathymetric lines on paper ruled to square millimeters, and to count the number of square millimeters between successive lines, estimating to tenths. This was done for areas 5° on the side, over all the oceans, and checked by counting the millimeters in each area as a whole. The area corresponding to one square millimeter was not determined by the scale of the map, but by dividing the area between the bounding parallels and meridians, as calculated on a Bessel's spheroid, by the total number of square millimeters counted in it. By this means errors due to inaccuracies in ruling the paper, or to shrinkage or expansion, were avoided. The errors that could not be avoided are due to inaccuracies of the maps and to lack of data for even large areas of the oceans, but it is not likely that Kossinna's results will be materially affected when these deficiencies are made up. The mean depth that he deduces for all the oceans is 3,800 ± 100 meters, somewhat greater than the best estimates made earlier. His measures can evidently be used for other purposes; for instance, to determine the ratio of land and water on the globe. This he finds to be 1 : 2.43; agreeing with Krümmel and differing somewhat from Wagner (1 : 2.54). He also applies his measures to find the ratio of land to water in the northern and southern, the land and the water, hemispheres, and to determine the areas and mean depths of all the oceans and seas of the earth. He combines with

his own measures the estimates of the mean heights of the continents and islands, given by other investigators, to draw a hypsometric curve, and to deduce the mean level of the solid crust, which he finds to be 2,440 meters below sea level. The paper is full of tables giving much information of the kind mentioned above and will be very useful to those interested in this line of earth science.

HARRY FIELDING REID

## A MANUAL OF MAP PROJECTION

C. H. DEETZ AND O. S. ADAMS. **Elements of Map Projection with Applications to Map and Chart Construction.** 163 pp.; maps, diagrs., index. *U. S. Coast and Geodetic Survey Special Publ. No. 68*, Washington, D. C., 1921. 50 cents. 11½ x 7½ inches.

This is, primarily, a working manual on map projections. Part I deals with the theory involved in representing a curved surface on a plane and explains in simple language the underlying principles of several of the more common projections. Part II deals with the practical construction of these projections and includes detailed instructions as well as the necessary tables, in most cases. The mathematical development of a few of the projections is given for the benefit of those who may wish to see how the formulae are derived; but otherwise the entire book is of an elementary nature and does not require a knowledge of higher mathematics for a full appreciation of its contents.

In Part II the following projections are treated in separate chapters: Polyconic, Bonne, Lambert zenithal equal-area, Lambert conformal conic, Albers conical equal-area, Mercator, and gnomonic. In addition, there is a chapter on world maps where various other projections are treated including the stereographic, Aitoff equal-area, Mollweide homalographic, Goode's homalographic (interrupted), Guyou's doubly periodic, and others. A comparison of several of these projections as regards the amount and location of the maximum distortion shown by illustration in the frontispiece.

The chapter on the polyconic projection includes a discussion of the transverse polyconic projection and the polyconic projection with two standard meridians as used for the International map of the world (tables for the polyconic projection are given in *U. S. Coast and Geodetic Survey Special Publication No. 5*).

Considerable interest attaches to the chapter on the Lambert conformal conic projection on account of the uses made of this projection during the World War. For a small country like France the projection is an ideal one on which to superimpose a grid or quadrillage system. For larger countries, such as the United States, the distortion of this projection becomes too great for military purposes, and some other projection or device must be used. The solution of this problem for the United States is explained in the chapter entitled "The Grid System of Military Mapping."

In many ways the best projection for a general base map of the United States or other large countries with a predominating east and west dimension, is the Albers conical equal-area projection, on account of the small scale distortion and because of other desirable properties. As explained in the chapter on this projection, it is very easy to construct, requiring only good judgment in the selection of the standard parallels.

Navigators will be especially interested in the chapter on the Mercator projection which includes Mercator tables. Considering the extensive use of this projection for charts, it deserves to be better understood and appreciated than is the case at present. The chapter on the gnomonic projection will also appeal to navigators on account of the special properties of this projection, which make it so useful as an adjunct to certain sailing charts and for charts on which to plot radio-compass bearings.

C. H. SWICK

## DANISH RAINFALL MAPS

KURT LEHMANN-TEGEL. **Regenkarten des Königreichs Dänemark.** 26 pp.; maps, diagrs., bibliogr. Dietrich Reimer (Ernst Vohsen), Berlin, 1919. M. 6. 12½ x 9½ inches.

Denmark is a small country, but with its irregular coast line, its numerous bays and peninsulas, and its outlying islands it presents, within a limited area, a considerable variety of climatic conditions. The new rainfall maps are based on observations at about 200 stations. The basic period is 1876–1915. Reductions to the uniform period, together with certain interpolations, have been made. The isohyets on the mean annual map are

drawn for 50-millimeter intervals, except that in districts of less than 550 millimeters of rainfall no isohyets are drawn. The scale of this map is 1 : 1,000,000. Topography is not indicated. The heaviest rainfall occurs in the western portion of the peninsula and is shown to be 750–800 millimeters (about 30 inches). Topography is, in these cases, an obvious control. In the southern part of Jutland three west-east rainfall zones may be distinguished. The first, on the west coast, has dominant general storm rains. The second, inland, receives its rainfall from barometric depressions as well as from summer thunderstorms, the latter predominating, while the former become less and less important toward the east. The third zone, on the east coast, has a further decrease of general storm rains and also a decrease of thunderstorm rains. It is an interesting fact that these changes in the type of rainfall occur over so limited an area. A decrease in rainfall towards the north is also shown. The smallest amounts are slightly less than 20 inches, i.e. roughly equivalent to the mean annual rainfall along the 100th meridian in the United States.

The twelve monthly maps are on a scale of 3 : 1,000,000, with isohyets for every 10 millimeters. August is the rainiest month for most of Denmark. October brings a secondary maximum. Continental and marine tendencies are thus both indicated. Autumn rains are characteristic of the west coast. The August maximum is found over the interior.

R. DeC. Ward

## A Biography of De Saussure

D. W. Freshfield. **The Life of Horace Benedict de Saussure.** xii and 479 pp.; maps, ills., bibliogr., index. Edward Arnold, London. 1920. 9½ x 6½ inches.

It seems somewhat surprising that over a century and a quarter should elapse after the death of De Saussure before his life was made the subject of an adequate biography. The name of De Saussure is intimately associated with two of the mightiest of the many intellectual and spiritual movements that had their origins during the closing years of the eighteenth century. One of these was that awakening love of nature and of mountains to which the romanticists gave expression in literature and in art and which has placed mountaineering in the foremost place not only among athletic sports but among recreations of the human spirit. The other was a movement in the realm of science away from the excessive theorizing and deductive reasoning that characterized eighteenth-century thought. It was a movement leading towards the work of men like Humboldt and Darwin, who founded their theories upon close observation of a multitude of facts. Humboldt was inspired to imitate the method of De Saussure whom he regarded as his master, and it "was the perusal of Humboldt's works which awoke in the young Charles Darwin the passion for travel and discovery" (p. 440).

At last justice has been done to the memory of De Saussure in the ample biography before us. By availing himself of the results of recent researches made by Mr. Henry F. Montagnier in the libraries and private archives of Geneva, Mr. Freshfield found at his disposal a wealth of hitherto unpublished material on De Saussure's career. The information obtained from these sources was supplemented by wide studies of the Genevan professor's scientific, literary, and political contemporaries, and the whole account is delightfully presented in a dignified and restrained, but vivid, English style. Indeed the book does far more than tell us of De Saussure. It introduces us to the leading figures of a critical period in the development of science and of mountaineering and gives us an intimate view of normal life in a refined intellectual and social circle of French-speaking Europe on the threshold of the French Revolution. By no means the least important part of Mr. Freshfield's biography are the pages devoted to Genevan politics during the last years of independence, the menace of the ideas that led to the great revolution in France, the final absorption of Geneva by France, and De Saussure's connection with these events.

De Saussure's fame, however, rests primarily upon his Alpine expeditions and upon researches in geology and meteorology. An illuminating chapter on the beginnings of interest in mountains and mountaineering enables us to estimate the importance of De Saussure's work in this respect. The claim has often been made that to Rousseau should be attributed the credit of arousing the mountaineering enthusiasm and appreciation of mountain landscapes that have become so characteristic of modern life. This claim Mr. Freshfield believes to be essentially false: Rousseau, who never even climbed a mountain and least of all ventured into regions of glacier and *névé*, was a lover and interpreter of the more placid scenery of lowland and foothill. If to any one individual belongs the

greater share of credit for having revealed the world of crags and ice it is to De Saussure. By offering a prize to the first man who should scale Mont Blanc, De Saussure urged the peasants of Chamonix to hazardous ventures ultimately crowned by success when Jacques Balmat reached the summit in August, 1786. After many attempts and delays, De Saussure himself achieved the ascent with a large party of guides the next year. This exploit created a prodigious sensation throughout Europe and is the feat for which De Saussure even now is most widely remembered, though more difficult and deserving of even higher praise was his long sojourn on the Col de Géant (1788) where he remained at an altitude of nearly 11,000 feet for over a fortnight carrying out meteorological observations.

Though De Saussure undeniably did much to open the way to future Alpinists, the main motives which induced him to undertake journeys in the Alps were neither a love of landscape nor a love of adventure. Before all else a scientist and geologist (he was the first to use the term *geology* in its modern sense), De Saussure was induced to explore mountains because he felt that they reveal far more advantageously than lowlands the structure of the earth and atmosphere and the "great processes of world-building" (p. 433).

The concrete results of his observations are too numerous to indicate here: indeed they were so numerous that Mr. Freshfield himself could but refer to them in a summary manner. In the field of geology his investigations led him among the first to an understanding of the succession of formations outward from the central core of a mountain range; in that of meteorology he invented many ingenious instruments and carried out extensive instrumental observations and experiments; his study of glaciers unfortunately yielded the least valuable results of his many researches.

The lasting scientific value of De Saussure's labors lay less in the originality of his theories than in the multitude of facts which he observed and the accuracy of his observations. He was criticized by contemporaries (possibly with some slight justification) for his hesitancy to theorize. It should be remembered, however, that death cut him short at the age of fifty-four when his life work was still unfinished and that at the time of his death he had in mind the composition of a great "Theory of the Earth" based upon his earlier work. It is to his lasting credit that he stood out valiantly against the often fantastically theoretical thought of his time.

# THE GEOGRAPHICAL REVIEW

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Mr. Fuller's work in economic geology has been especially applied to coal, petroleum, and water-supply problems. He organized the eastern division of hydrology of the U. S. Geological Survey, the work of which has been dealt with in many Water Supply Papers. Mention too, may be made of "Geology of Long Island, N. Y.," *U. S. Geol. Survey Professional Paper 82*, 1914. In 1913–1915 Mr. Fuller carried out extensive explorations in China, Manchuria, and Mongolia. He has also been conducting investigations in Cuba and Haiti and Arctic Canada.

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# NOVAYA ZEMLYA, A RUSSIAN ARCTIC LAND

By OLAF HOLTEDAHL
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## INTRODUCTORY AND HISTORICAL

The twin islands of Novaya Zemlya, curving like an immense arc from northwest to northeast, stretch northwards for no less than 1,000 kilometers into the Arctic Ocean, west of the point where European Russia touches Siberia. It was the efforts to find the northern sea passage to the rich countries of the East that led the first Western Europeans to Novaya Zemlya in the sixteenth century. The way to the White Sea and the mouth of the Dvina having been found by Chancellor on Sir Hugh Willoughby's well-known expedition in 1553,[1] the English Muscovy Company in 1556 sent out another expedition led by Stephen Burrough, who had taken part in Chancellor's voyage, with instructions to find his way to the Siberian rivers. He did not achieve this object but penetrated as far as the Kara Strait and the southern part of Novaya Zemlya. Nevertheless, Burrough cannot be called the discoverer of these islands, as they were already known to the Samoyeds and hunters of Northern Russia, who called them Novaya Zemlya, i.e. the New Land. During the last decade of the sixteenth century the Dutch began their voyages in the northeast. In 1596 Willem Barents' last and most famous voyage took place, on which occasion he first rediscovered Spitsbergen and then sailed round the northern cape of Novaya Zemlya. Afterwards, however, his ship was caught in the ice, and he had to winter on the east coast at about latitude 76° 15′ N. As is well known, Barents himself never returned. He died from illness, but his men, after an adventurous voyage, finally reached Kola in northern Russia in the ship's boats.

During the seventeenth century several important Dutch and English expeditions explored the seas around Novaya Zemlya, and well on in the

1 Willoughby has been accredited with sighting Goose Land, the Westernmost part of Novaya Zemlya, but Nordenskiöld does not consider this probable (The Voyage of the Vega, London, 1881, Vol. 1, p. 62).

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FIG. 1—Panorama from the southern side of Mashigin Fiord, western coast of Novaya Zemlya, at an altitude of 2,300 feet above sea level. (Photograph by R. Lund.)

eighteenth century the Russian explorations began. Of these the best known are Loschkin's and Rosmyslov's voyages about 1760. The latter explored the Matochkin Shar, the long winding sound which severs the country into two parts. But it was not until 1820 that the Russian authorities took up the exploration of Novaya Zemlya in earnest. Lieutenant (afterwards Admiral) Lütke investigated and mapped roughly large areas of the west coast in 1821–1824. Important geographical investigations were carried out on the east coast in 1832–1835 by Pakhtusov, the last two years in conjunction with Zivolka. Since that time the islands have been visited by numerous expeditions, both Russian and others, but it would carry us too far to take up in detail these more recent explorations. A great many European nations have at one time or another contributed to the work,[2] and I may mention that an especially important contribution to our knowledge of the northernmost part of Novaya Zemlya has been given by Norwegian sailors, who in their small sailing vessels have made numerous voyages in these waters, especially in the years about 1870, for seal, walrus, and polar bear hunting.

In spite of these explorations, however, Novaya Zemlya is still in many respects a little-known region. The east coast of the northern island, where, even in summer time, the drifting ice makes navigation es-

[2] See for example Charles Bénard: Dans l'Océan Glacial et en Nouvelle Zemble, Paris, 1909 (list of chief expeditions on pp. 189–190,) and *idem:* Un été chez les Samoyèdes, Paris, 1921, reviewed elsewhere in this number of the *Geographical Review*.

pecially difficult, is in every respect very little known, even from a purely geographical point of view. Not even the main features of the coast line are known. Detailed and correct maps are entirely lacking for practically the whole country; those which exist are mainly sea charts, including only a few limited areas, mostly on the southern island, principally near the Samoyed colonies.

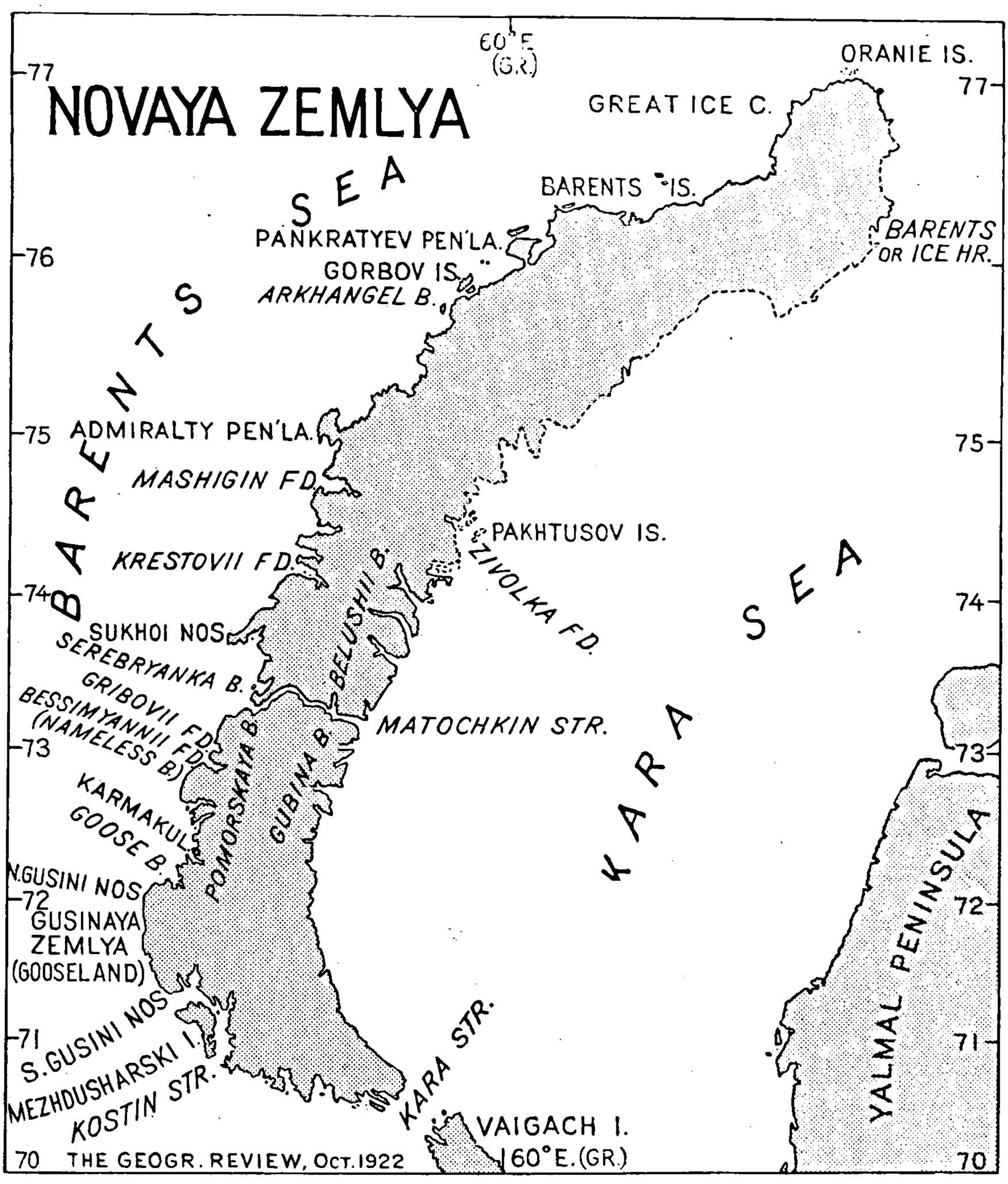


FIG. 2—Outline map of Novaya Zemlya

## GENERAL GEOGRAPHY AND PHYSIOGRAPHY

Novaya Zemlya is divided into two islands by the narrow Matochkin Strait. This dividing line, however, does not in any way signify a boundary between two areas of different character. The country just north of the sound, and that south of it, are in every respect identical both as regards surface formations and geology, and Novaya Zemlya may be regarded as a geographical unit. Stretching from latitude 70½° to 77° N. the island exhibits wide differences in the south and north, as regards the ice covering. There are also considerable differences in altitude. Novaya Zemlya is the remnant of an ancient mountain range folded up in Permian time. To a

great extent the same geological strata run lengthwise through the country, but the exposure of the several series of strata varies, and, as the various rocks weather very differently, we have a varied relief.

The middle part of the southern island shows a comparatively low, yet broken relief developed on strata of shale alternating with sandstone, a formation referred to as Permo-Carboniferous by the Russian geologist M. Chernyshev who in 1895 made a cross-country journey a little north of the 72nd parallel. A great part of the surface is less than 300 meters above sea level, and the greatest altitudes probably do not here exceed 500 meters. The low-lying Goose Land, the broad peninsula forming the westernmost part of Novaya Zemlya, has an average elevation of less than 70 meters above sea level. It is strewn with numerous large shallow lakes.

Both south and north but especially north of this middle area of the southern island we meet with higher country. To the south-southeast of Kostin Shar rise ridges that probably attain heights of 600–700 meters, whilst in the north, towards the Matochkin Strait, altitudes of 1,000 meters and over are found. These higher areas consist of a series of harder rocks, sandstones, quartzites, conglomerates, and dolomites which in part belong to the uppermost Cambrian,[3] in part to the Devonian, while in an extreme western belt are Carboniferous limestones. Chernyshev described a comparatively well defined boundary, along a line of faulting between the mountainous area near Matochkin Strait and the lower land to the south. In reality, however, no such fault seems to exist, and there is a gradual change in the landscape, which rises regularly to the north.

Between 73° and 75° there is along the west coast a strip of low, flat land sometimes as much as 10 kilometers in breadth and less than 100 meters in height. This strip—and no doubt Goose Land too—corresponds to the coastal plain, *strandflaten*, of Norway and Spitsbergen, cut by marine erosion at a time preceding the last complete glaciation of the islands. From this plain sharply defined mountains rise abruptly up to the height of 700–1,000 meters—probably nowhere exceeding 1,100 meters. Such elevations are maintained to about halfway across the island where the mountains gradually become lower, until near the east coast they give way to plateau-like landscapes, with altitudes of 300–500 meters. It is in these middle latitudes that we find the most typical fiord topography, with narrow fiords reaching from 30 to 40 kilometers inland. On the softer rocks of the mountain slopes we find a characteristic development of beautifully defined raised beaches, terraces cut in the shore line during a late Quaternary submergence of the land. The highest terrace that is undoubtedly marine lies 200–240 meters above sea level, the difference in different places being due to an uneven raising of different parts of the land mass. That these terraces represent old beaches is proved also by the occurrence of marine mollusks at corresponding heights. At Archangel Bay shells were found at a

[3] The recent examination of the paleontological material collected during the Norwegian expedition has shown the rather unexpected fact that the oldest Paleozoic formation is represented in Novaya Zemlya.

FIG. 3

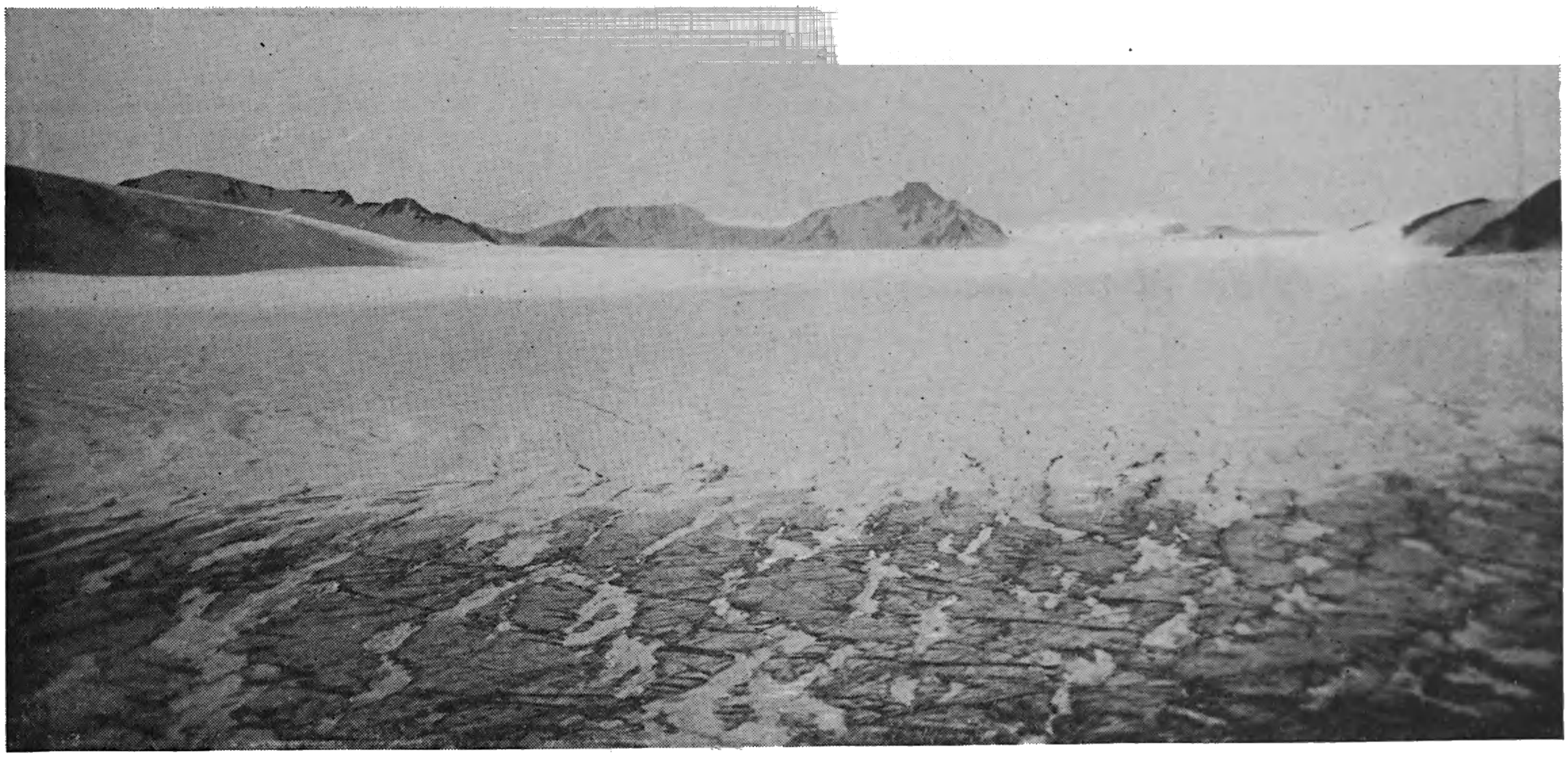

FIG. 4

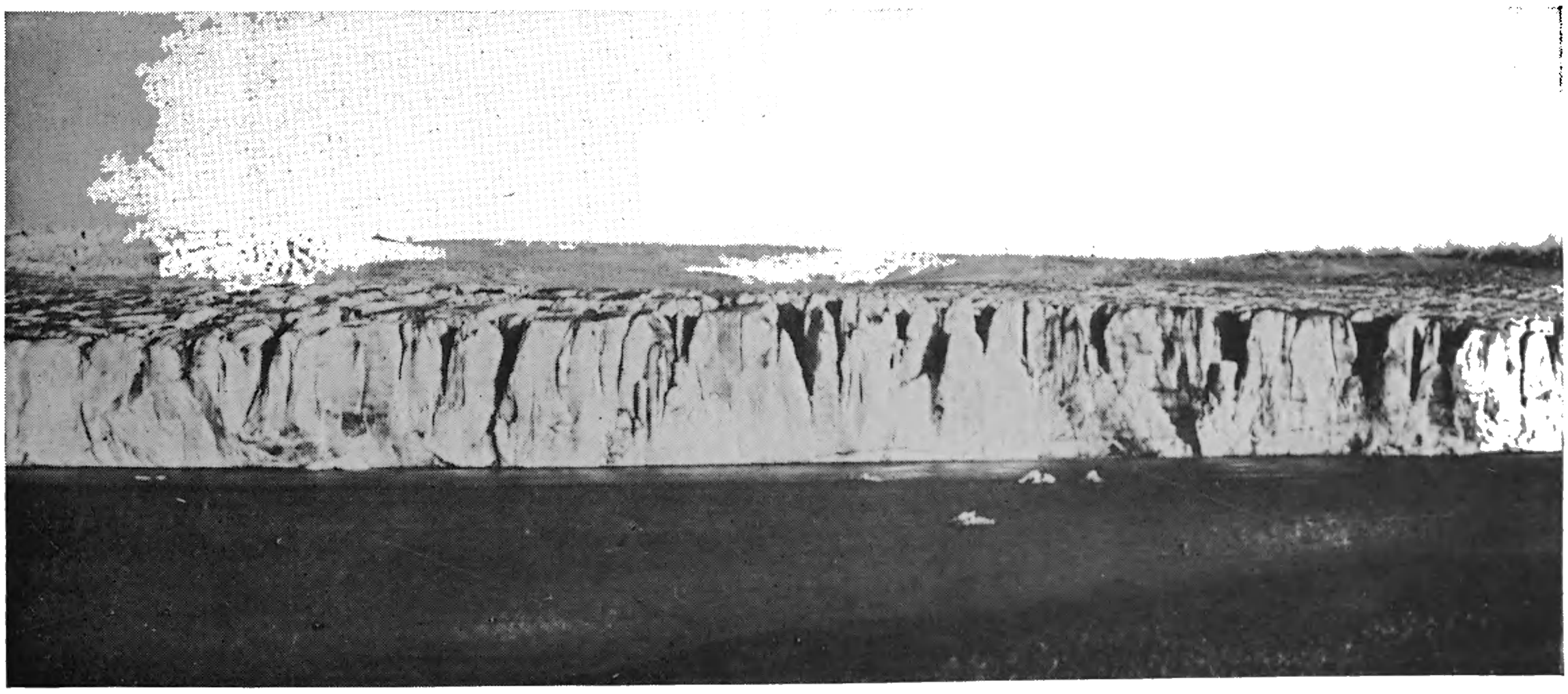

FIG. 5

FIG. 3—River on glacier on the Gorbori Islands, northwestern coast of Novaya Zemlya. (Photograph by O. T. Grönlie.)

FIG. 4—Glacial plateau about 1,650 feet above sea level north of the inner part of Mashigin Fiord. In the foreground the snow has melted, exposing the old dark ice. (Photograph by O. T. Grönlie.)

FIG. 5—Front of glacier (height about 100 feet) on the southern side of the narrow inner part of Mashigin Fiord. (Photograph by R. Lund.)

FIG. 6

FIG. 7

FIG. 6—The innermost part of Bessimyannii Fiord (Nameless Bay), Western coast of Novaya Zemlya. Note the raised beaches on the fiord walls and the widespread delta deposits. (Photograph by R. Lund.)
FIG. 7—The middle part of Matochkin Strait, the channel dividing Novaya Zemlya into two islands. (Photograph by B. Lynge.)

FIG. 8

FIG. 9

FIG. 8—An Arctic desert. The southern side of Pankratyev Peninsula, northWestern coast. The cliffs defining the coast line are 30 to 60 feet high. (Photograph by B. Lynge.)

FIG. 9—DriftWood along the inner part of the bay on the southern side of Pankratyev Peninsula. Raised beaches at several levels are cut in the moraine hills in the background. Beyond is the inland ice. (Photograph by B. Lynge.)

height of 239 meters by the recent Norwegian expedition. Small isolated glaciers occur as far as 30–40 kilometers south of the Matochkin Strait but not farther south. No glacier reaches the sea along the strait, but one glacier on the north side has its lower end on the lowland very near the sound. From about 74° northwards glaciers reach the inner ends of the fiords, and their dimensions constantly increase northwards. On a sledge trip from the Mashigin Fiord to the Zivolka Fiord on the east coast, I crossed from coast to coast on glaciers whose surface was generally less than 400 meters above sea level.[4] Inland at these latitudes there is more ice surface than rock.

FIG. 10—Flowering plants of the eastern part of Matochkin Strait (latitude 73°N.). *Silene acaulis* with *Myosotis* and *Papaver*. (Photograph by B. Lynge.)

Farther north, the glaciers become still more dominant, and at 76° we may speak of inland ice. Practically speaking, the mountains rise above the ice only near the coasts. The ice there also forms an integral part of the coast line. The western coastal mountains north of 76° occasionally rise to 1,000 meters but are most often considerably less.[5] Concerning the east coast exceedingly little is as yet known.

## BIOLOGY

The fauna and flora of Novaya Zemlya are in general very like those of Spitsbergen. The reindeer, which was formerly fairly common, is now mainly found along the east coast; and where the ice lies close to the shore the polar bear often lands. The polar fox also is rather common. Of smaller mammals there are species of lemming. In the fiords and on the ice near the

[4] Olaf Holtedahl: A Crossing of Novaya Zemlya, *Geogr. Journ.*, Vol. 59, 1922, pp. 370–375.

[5] Cf. the map made by Lieutenant Sedov's Wintering Expedition 1912–1913, published in L. Breitfuss's article on the expedition in *Zapiski po gidrografii*, Vol. 42, 1918, Petrograd.

coast we meet various species of seal (especially *Phoca barbata* and *P. foetida*) in great number, and on the east coast also the walrus. The white whale (*Delphinapterus leucas*), which was formerly very common, is still seen along the shores.

As in other Arctic islands, the main characteristic of the higher fauna is the bird life.[6] Geese of several species are seen in enormous numbers in the lowlands, especially on the southern island, eider-ducks are very common, and there are innumerable precipitous cliffs where thousands of looms (Brünnich's guillemots, *Lomvia bruennichi*) and various species of gulls

FIG. 11—Flowering plants at Serebryanka Bay, north of the Western end of Matochkin Strait. *Valeriana capitala* and grasses.

(especially *Rissa tridactyla* and *Larus glaucus*) have their breeding places. There is also an abundance of smaller birds, among others several species of stints (*Tringa*) and the snow bunting (*Plectrophenax nivalis*), the latter being the most common land bird seen. Of larger land birds might be mentioned the snowy owl (*Nyctea scandiaca*). On the southern island Bewick's swan (*Cygnus bewicki*) is found. The rivers and lakes generally are poor in animal life, but a fine species of salmon, *Salmo alpinus*, occurs fairly commonly in some of the fiords of the western coast and enters the rivers there. At first sight insect life appears to be meager, nevertheless the number of species has proved to be very great; of one group alone, beetles, the Norwegian expedition last summer found some twenty species.

No trees nor erect bushes are to be found even on the southern island, yet flowering plants occur in fairly large numbers. A total of about 150 species has been found in the southern island. This number decreases farther north.

[6] Compare A. H. Markham: A Polar Reconnaissance, London, 1881, p. 151, and H. J. Pearson: Beyond Petsora Eastward, London, 1899.

Dr. Lynge, the botanist of the Norwegian expedition, found about 60 species on the west coast at about latitude 76°. Among the most common higher plants are species (about 10 in number) of Salix, their thin branches always creeping along the ground; also Saxifraga is represented by an equally large number of species.[7]

Nevertheless, there is an abundance of tree trunks to be found along the coast, carried there by the ocean currents chiefly from the Siberian estuaries. This Siberian timber has drifted a long distance before stranding here. It passes south of Franz Joseph Land, then drifts southwestward towards Bear Island, where it is caught by a drift from the Gulf Stream, the North Cape current, and carried along the Novaya Zemlya coasts. Incidentally it may be

FIG. 12—The Samoyed colonists at Pomorskaya Bay, Western end of Matochkin Strait. The little church in the background. (Photograph by R. Lund.)

remarked that to this warm current is due the circumstance that the greater part of the west coast in most years is fairly free from ice during late summer and early autumn; and it is this current which makes possible such a comparatively rich vegetation.

## THE SAMOYEDS

Before 1870 Novaya Zemlya had no permanent inhabitants, whilst on the mainland to the south and on the island of Vaigach reindeer-keeping Samoyeds led a nomad life. On account of the length of time the northern coast of Russia remains icebound the riches of the sea near Novaya Zemlya were utilized more by Norwegian sealers than by the Russians. It was to remedy this state of affairs that there was started, by the initiative of the Grand Duke Alexis Alexandrovitch, a colonization of the southern island. In 1877 five Samoyed families, numbering in all 24 persons, were trans-

[7] A description of the flowering plants of Novaya Zemlya is given in the appendix by Col. H. W. Feilden to H. J. Pearson's "Beyond Petsora Eastward," London, 1899.

ported from the Russian mainland, from the Mezen district on the east side of the mouth of the White Sea, to Little Karmakul on the west coast of the southern island, somewhat to the north of Goose Land. Later on other families joined the first.[8] Some of them soon moved north to the entrance of Matochkin Strait (Pomorskaya Bay), where there were better opportunities for hunting polar bears. In 1897 a third colony was founded at Belushii Bay on the southern side of Goose Land, and finally a small colony has come into being in the inmost part of the Krestovii Fiord. Personally I have seen only the last-named and the colony at Pomorskaya Bay, and in both places there are but a small number of persons, in the Krestovii Fiord about 10 and at Pomorskaya about 30, children included. The more southern colonies are larger, and here Russian priests are stationed.

The Samoyeds live in solidly-built wooden houses, the material of which has been brought over from Russia. They live chiefly by hunting and salmon fishing and also receive every summer (in exchange for their furs) some provisions, more especially flour, sugar, tea, tobacco, arms, and ammunition, and other articles from Russia. Supplies, it may be noted, were received last summer. The Samoyeds wear garments of reindeer skin for the most part, though the women have bright-colored materials imported from the south for their "Sunday" clothes. They do not keep tame reindeer, but on the other hand they have a large number of dogs, which they employ to draw their light sledges. For a large part of the year the men are out hunting, taking with them their families and living in tents.

[8] See the account of the settlement made in 1894 by A. P. Engelhardt, Governor of the Province of Archangel, described in his book "A Russian Province of the North," London, 1899, pp. 198 *et seq.*

# THE GEOGRAPHY OF FAIRS: ILLUSTRATED BY OLD-WORLD EXAMPLES

By André Allix
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The fair is one of the most characteristic features of Old-World commerce, whether considered historically or in respect of certain particular products. Yet it is a subject that has inspired little geographical study.[1] The reason doubtless lies in the fact that in all western Europe general fairs on a large scale are an institution of the past, while the surviving fairs are too restricted in their sphere of interest as regards place or products to have attracted attention. The recent sample fairs appear to represent a permanent feature of international trade, but their creation is too recent to have permitted geographical analysis.

From the geographical point of view the problem seems to have been complicated by the confusion of four analogous institutions which may exist side by side or in combination but which are fundamentally distinct and go back most probably to at least two different origins. In the one group figure the general commodity fair and the recently created sample fair; in the other the town market and the cattle fair. The commodity fair represents the sole mechanism of large-scale commerce, and especially international commerce, in a state of civilization, when there was no security for regular exchange nor were means of transportation organized; it has declined with the progress of material civilization. The sample fair is a creation of today and in some measure artificial. It is directly derived from the commodity fair though perhaps best described as a resurrection of it under an entirely new guise and adapted to modern needs.

The town market and the live-stock fair appear to have been united in the beginning and to have arisen from the same causes and the same geographical conditions. But they early became dissociated, responding to different needs, and finally became distinct. The town market which today retains its old-time characteristics is not germane to the present discussion. The live-stock fair, an apparent derivative of the commodity fair, is in reality an independent institution, perhaps the more ancient in its fundamentals and at all events the more persistent, for it still flourishes at the present time. Unlike the commodity fair it is not the response to changing economic and social conditions of a certain stage of civilization but to natural controls of pastoral life.

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[1] Practically all the geographical studies written on this subject concern live-stock fairs (see pp. 546–557 of this article). See also G. M. Wrigley: Fairs of the Central Andes, *Geogr. Rev.*, Vol 7, 1919, pp. 65–80. The works already published on the subject of fairs, though almost exclusively by historians and jurists, furnish abundant documentary material from which it is possible to draw clear ideas as to the nature of the institution in its geographical implications.

## Commodity Fairs[2]

### Origin of Fairs

Travelers in primitive countries often remark the more or less periodic gathering at customary places and dates of men from different tribes representing unlike modes of life—that is of people having products to exchange. The animated crowd trafficking one day in the midst of dust and noise is dispersed in the evening to regain the more or less secluded and fortified places where the daily existence of the tribes is pursued. In this way arises a primitive commercial organ permitting backward folk to reconcile two contradictory needs; seclusion for safety and intercourse for exchange.

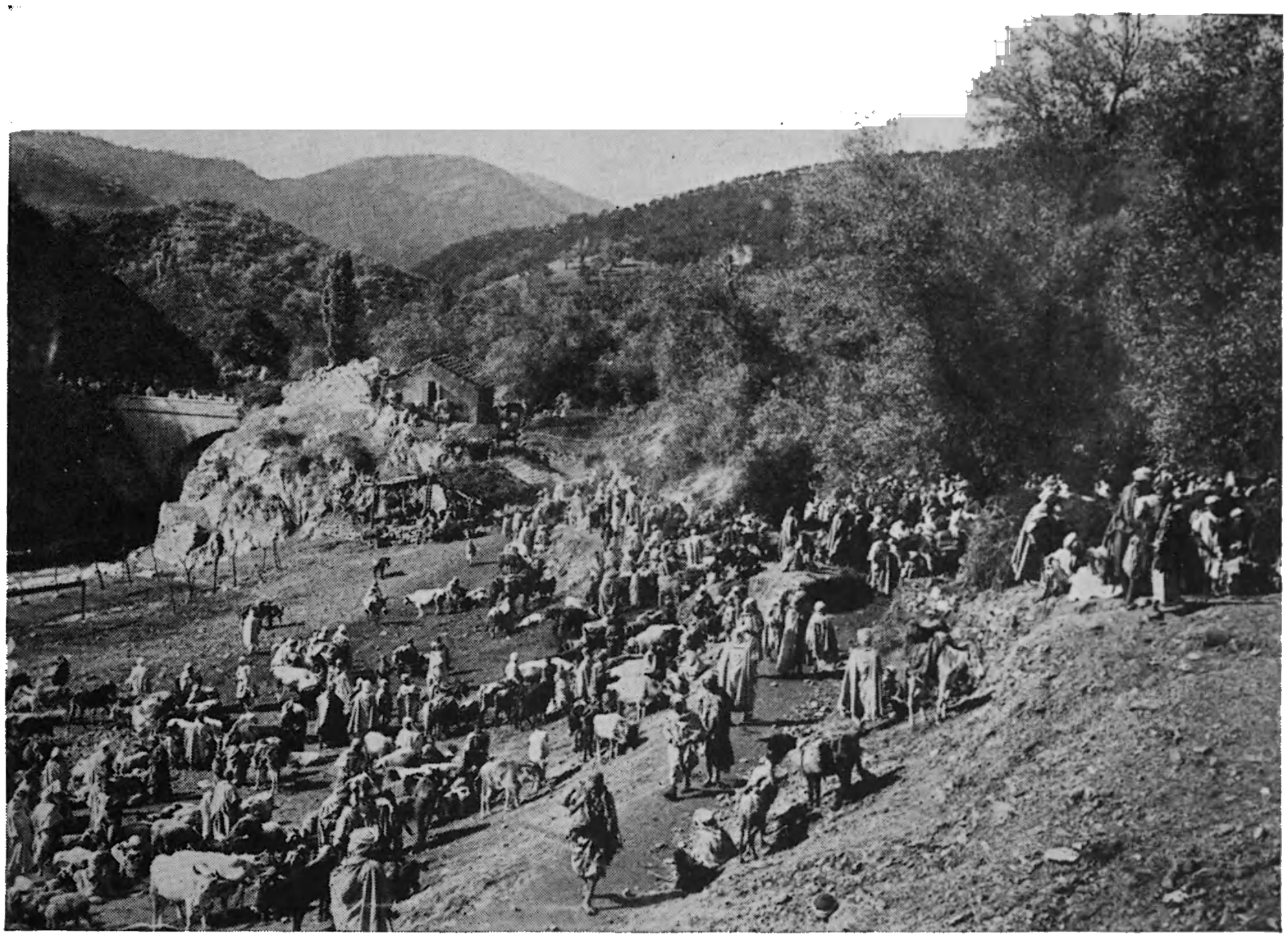

FIG. 1—Market fair in northern Africa held in the open country. The weekly fair of Suk-el-Jemaa in Kabylia. (Photograph by Raoul Blanchard.)

The place of exchange is a sort of *neutral ground*, and the period of exchange a *truce* where the normal state of existence, if not of warfare, is at least of hostile indifference.[3] In its rudimentary form this kind of commerce is what German writers have termed *Grenzhandel*, "frontier commerce."[4]

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[2] A wealth of facts and valuable bibliographical references are to be found in Paul Huvelin: Essai historique sur le droit des marchés et des foires, Paris, 1897. See also Cornelius Walford: Fairs, Past and Present, A Chapter in the History of Commerce, London, 1883.

[3] Numerous instances of the neutral character of these primitive trading assemblies are given by P. J. Hamilton Grierson in "The Silent Trade" (Edinburgh, 1903) in a section of which is traced the connection between the primitive market and the still more primitive commercial method of the "silent trade." R. Hennig in "Der 'Stumme Handel' als pandemische Erscheinung" (*Zeitschr. fur Sozialwissenschaft*, Vol. 10, 1920, pp. 10–12, Leipzig), also expresses the opinion that the "blind and dumb" trade of primitive peoples is the origin of large-scale commerce and especially of commerce by fairs.

[4] Fr. Graebner: Handel bei Naturvolkern, in Karl Andree's "Geographie des Welthandels" (3 vols., Frankfurt on the Main, 1910–13), Vol. 1, pp. 149–218; reference on pp. 158 *et seq.*

In the South Sea Islands the sound of a sacred drum announces the opening and closing of the truce. On the Congo during the period devoted to commerce the carrying of arms is strictly interdicted. By reason of their nature these meetings generally avoid inhabited places, a primitive feature that is often long persistent. In Africa today most of the periodic markets are held in the open country.[5]

Upon such gatherings for exchange nature imposes a certain periodicity more or less related to the variations of the season and the working calendar of these "nature" people, *Naturvölker* of the German writers. The periodicity may be of considerable amplitude: among the nomads of northern Asia commercial contact with the outside world is made only once a year.[6] When the requirements of exchange become more complex merchandise must be transported from a distance. But the ways of communication are still the rough roads furnished by nature. Security is precarious. Every convoy must be organized to withstand the natural perils and the menace of pillage; thus arises the caravan. Normally the caravan is a numerous body every member of which is assigned his definite function under the absolute authority and conduct of a responsible chief. The familiar comparison between a caravan and a ship may be recalled.

At this stage of civilization the only vehicle of commerce on a large scale is the caravan. Now by definition it functions intermittently, hence commerce must also be intermittent. To minimize inconvenience movements of caravans at an early date became regular, that is periodic. It was thus in the times of Herodotus and Strabo, as it is now the rule in Arab countries. Naturally the return of caravans at fixed times to their accustomed "ports" was followed by gatherings for trade. As the great religious festivals also drew great concourses of people, it was mutually advantageous to have them coincident: the caravans found it to their interest to arrive at the times of the festivals; the sovereign power that established the fairs—as was the case in historic times for the most part—fixed them on the great feast days. The word "fair" (the etymology is no longer in doubt) is from *feriae*, feast.

It may be remarked that in Christian countries the great festivals which most often accompany the great fairs are those of the warm season. They are Easter, Whitsuntide, Trinity; then the six great saints' days which follow month by month—St. John (June 24), St. James (July 24), St. Bartholomew (August 24), St. Matthew (September 21), St. Simon and St. Jude (October 28), and St. Andrew (November 30). Some fairs occur at Christmas and Epiphany, but they are less numerous. In the non-Christian countries there is a similar resemblance between the religious, the commercial, and the climatic rhythm. Political anniversaries sometimes play a like part to the religious festivals.

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[5] Giotto Dainelli and Olinto Marinelli: Risultati scientifici di un viaggio nella Colonia Eritrea, Florence, 1912.

[6] Graebner, *op. cit.*, p. 163.

Yet there are fairs which now at least do not appear to correspond to any festival date, and such cases are not infrequent. In some instances—and these are rare—the two events appear never to have been coincident; in others—as is ordinarily the case—they were originally connected but for reasons of convenience have been dissociated. And again the festival phase can survive the fair proper, of which it may remain the only souvenir.

However, the fair, because it is a commercial institution, will naturally be far more dependent on the physical conditions ruling the movement of caravans than on the social and historic factors regulating the feasts. But, as we have pointed out, coincidence of the fair with a feast augments its chances of continued success. Under this more complex form the commodity fair remains much as we have defined it in its primitive state. It arises from the combination of the two factors, frontier commerce and caravan transport.

## The Great Commodity Fairs: Historical Summary

The most ancient association between caravan trade and the fair goes back to China in the twelfth century before our era.[7] It is seen in ancient India, in the days of Babylon and Nineveh, then in Egypt, Nubia, and Arabia at the time when the Phoenicians were the great intermediaries of international commerce.[8] The national assemblies of ancient Greece with their religious ceremonials and games were at the same time the opportunity for merchandise fairs. The most important of these, owing to an admirable geographical position, were those of Corinth, seat of the Isthmian Games.[9] Significantly enough, under the Roman Empire the rôle of the fairs diminished, thanks to the *pax romana*, which guaranteed regular trade sufficient security and facility of transport.[10] But this was only temporary: the barbarian invasions followed.

At the beginning of the Middle Ages, during the "Frankish period," it is known[11] that a considerable number of fairs were legally guaranteed and frequented by international merchants; Greeks, Syrians, and Berbers there met Frisians and Saxons. Amongst these fairs the origin of some can be traced to the Roman period; others had their beginnings in the Germanic juridical institutions (*malli* or *placita*); others, the most numerous and important, were established on the occasion of festivals and Christian pilgrimages. The first known fair under this form is that of Saint Denis, near Paris, established by the Frankish monarch in 629 under a charter which was renewed three times in the following century. This fair, which appears to have changed its date in the ninth century, remained for five hundred years one of the centers of European commerce.

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[7] E. C. Biot, transl.: Le Tcheou-li, ou rites des Tcheou, 2 vols., Paris, 1851.

[8] F. K. Movers: Die Phönizier, 3 vols (uncompleted), Berlin, 1841–59; reference in Vol. 2, Section 3 (Handel und Schiffahrt), pp. 134 *et sqq.*

[9] Huvelin, *op. cit.*, pp. 75 *et sqq.* (ancient texts quoted and bibliography); Walford, *op. cit.*, pp. 3 *et sqq.*

[10] Huvelin, *op. cit.*, pp. 80–135.

[11] *Ibid*, pp. 143–176.

Up to the fifteenth century it was the French fairs that played the chief rôle in western Europe. From the twelfth to the fourteenth centuries those of Champagne[12] and Flanders[13] led in importance. They were regularly frequented by merchants from all parts of Europe and all northern Africa, Palestine and Syria, and Asia Minor. The Italians in particular enjoyed a

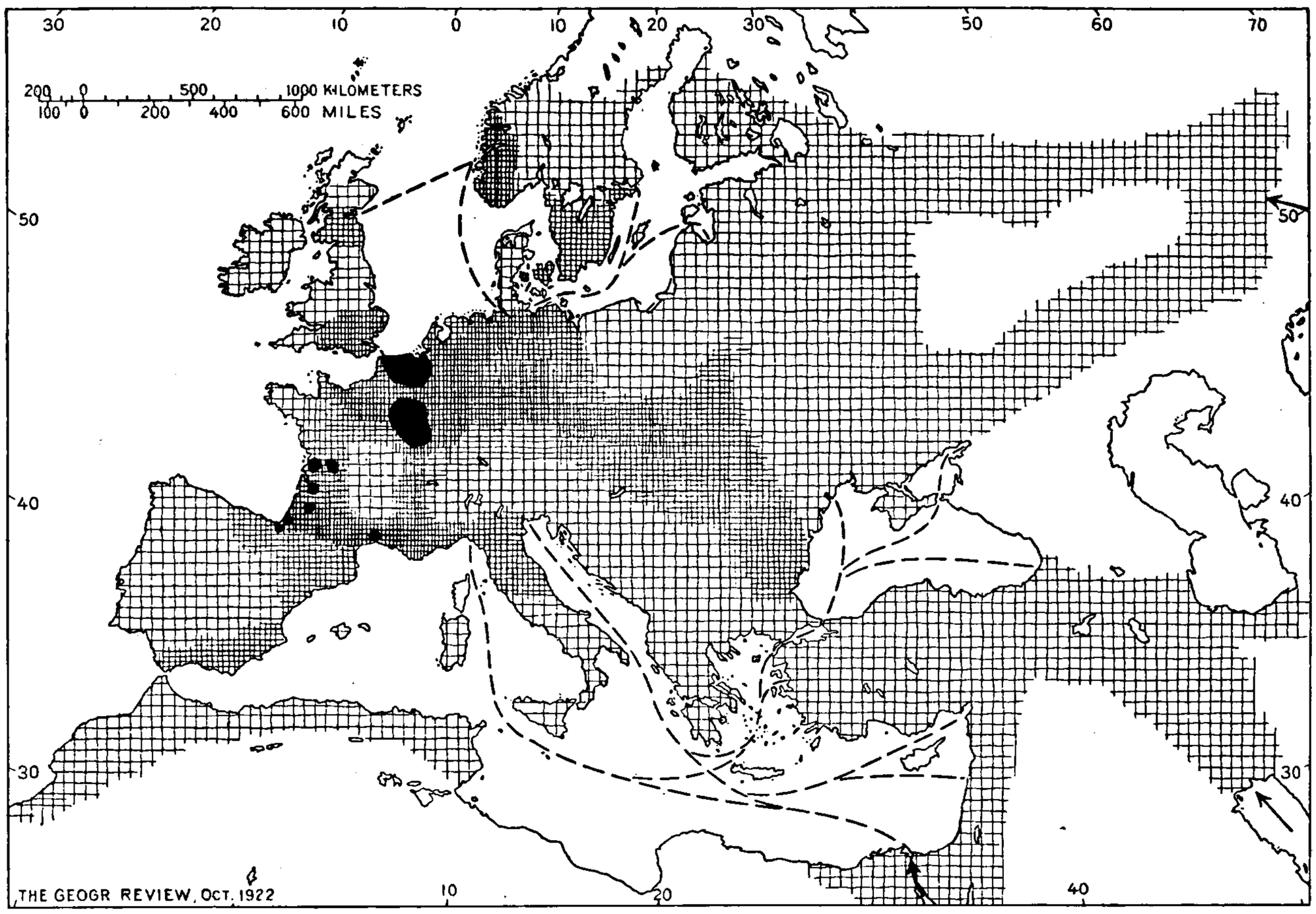


FIG. 2—The economic sphere of the most important commodity fairs of Europe in the twelfth to fifteenth centuries; the fairs of Champagne and Flanders. The large black patches represent the territory over which the fairs were held, Champagne to the south, Flanders to the north. The hachures represent the regions having regular relations with the fairs, the depth of shading corresponding approximately to the degree of relative importance. Broken lines show the principal routes of maritime traffic, and arrows the direction of imports brought from the Far East (*a*) by Arab navigators, (*b*) by Russo-Chinese caravans.

notable share of the business of the fair, sharing the monopoly in banking operations with the Jews. They were also great importers of eastern goods bought by Genoese and Venetian mariners from Arab traders or Russian caravans on the shores of the Black Sea and the Nile delta. One of the characteristics of these two great fairs was that they were not held at single centers: they may be described as constellations of fairs. Those of Champagne were held in four towns, Provins, Troyes, Bar-sur-Aube, and Lagny-sur-Marne; those of Flanders in several places but more particularly at Thourout, Bruges, Ypres, Lille, and later at Ghent and Antwerp. The chief advantage of this subdivision was that, passing on from one center to another, the fairs were distributed throughout the year and thus in fact constituted a permanent market.

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[12] Félix Bourquelot: Études sur les foires de Champagne, 2 vols., *Mémoires Présentés . . . à l'Acad. des Inscriptions et Belles Lettres*, Ser. 2, Vol. 5, Paris, 1865.

[13] Victor Gaillard: Essai sur le commerce de la Flandre au moyen-age: Troisième étude, les foires, Ghent, 1851.

In the fifteenth century European commerce was shared between two rival fairs, Geneva[14] and Lyons.[15] After long strife Lyons gained the ascendancy and until the middle of the sixteenth century held unquestioned supremacy among the fairs of Christendom. The Lyons fair was held for the period of a fortnight four times a year—in January, at Easter, in August, and

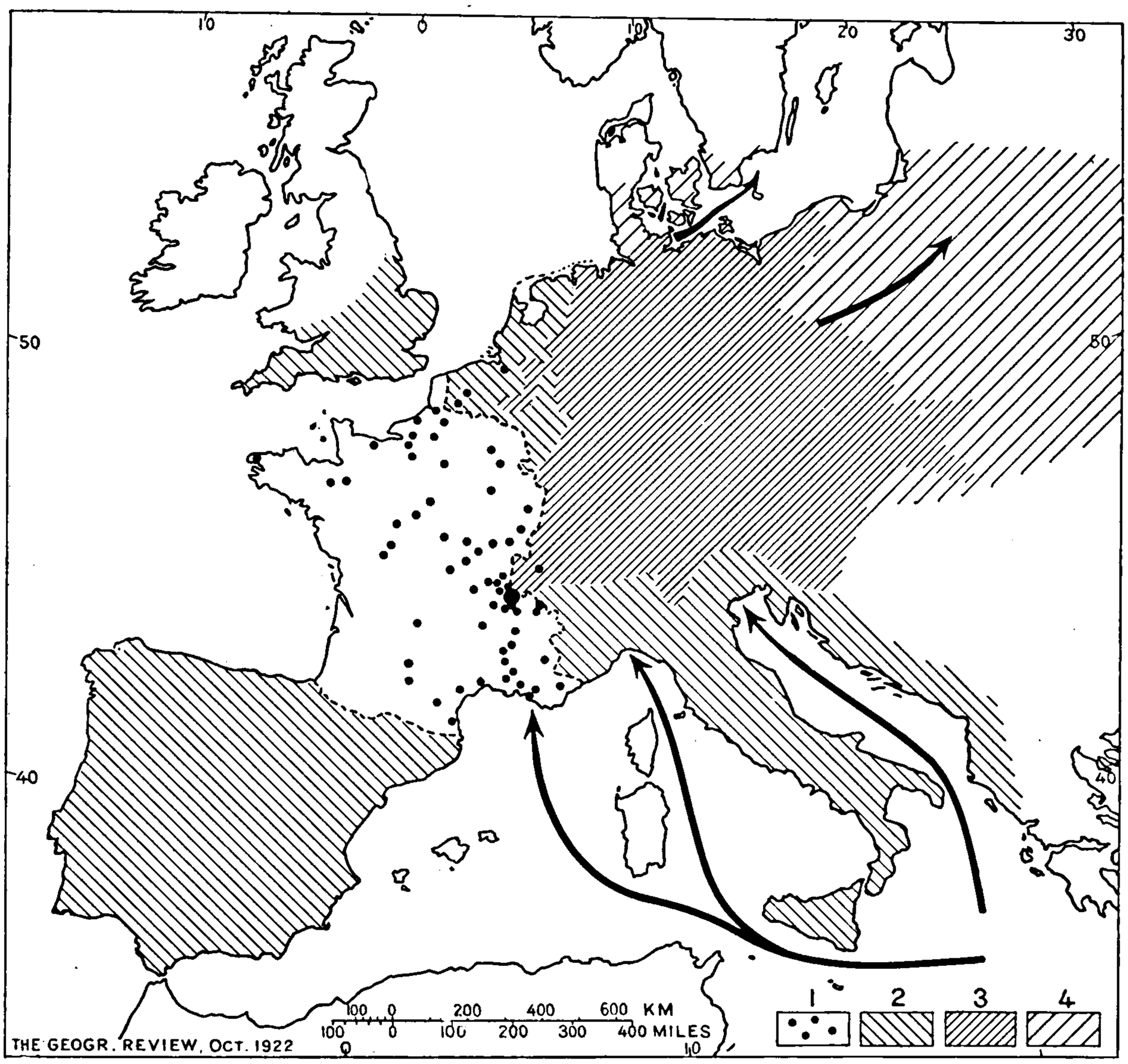


FIG. 3—The economic sphere of the sixteenth-century fair of Lyons. The numbers have reference to the fair: 1, chief industrial towns sending thither merchandise; 2, foreign countries especially interested in import; 3, countries chiefly interested in export; 4, countries of re-exportation. Arrows show direction of importation from the East and re-exportation to northern and eastern Europe.

in November. It was not only the central organ of exchange for the various regions of France but by its location as the point of transit for foreign commerce was a European rather than a French fair. It was through this fair that the products of the Mediterranean and the East were put into general circulation; notably it provisioned the German fairs, which in turn distributed merchandise throughout northern and eastern Europe.

The golden age of the German fairs[16] commenced later, though they have an origin almost as ancient as those of France. Cologne dates from 973, Mainz from 975, Leipzig from 1268. But they only assumed an international

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[14] Frédéric Borel: Les foires de Genève au quinzième siècle, Geneva and Paris, 1892.

[15] Marc Brésard: Les foires de Lyon aux XVe et XVIe siècles, Paris, 1914.

[16] Philippi: Beiträge zur Geschichte und Statistik der deutschen Messen, Frankfort on the Oder, 1858. R. Ehrenberg: Das Zeitalter der Fugger, 2 vols., Jena, 1896.

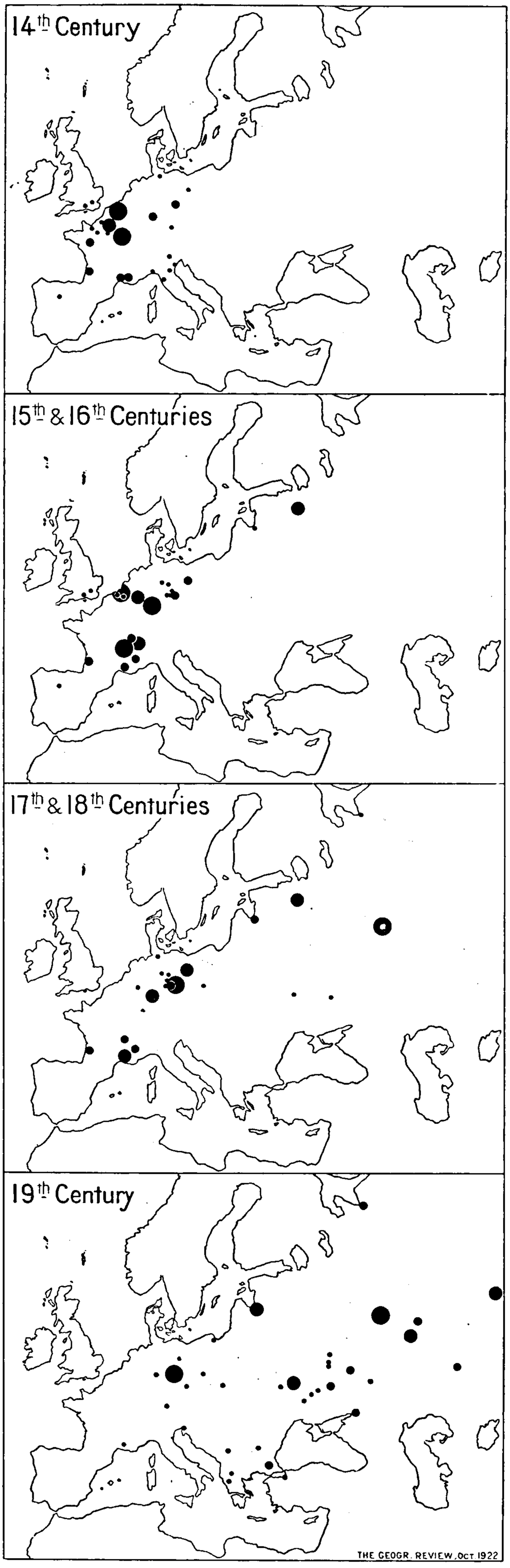


FIG. 4—The eastward migration of the great commodity fairs of Europe. Circles of four orders of magnitude are used to show approximate importance.

aspect when the religious wars waged in France in the sixteenth century had destroyed the security of that country's fairs; while at the same time the great axes of European trade were displaced from the Mediterranean to the Atlantic and the North Sea. During the sixteenth century the preponderant rôle was held by Frankfort on the Main;[17] after the Thirty Years' War it passed to Leipzig, which kept it until the nineteenth century.[18] After a long period of rivalry the German fairs ended by dividing the year between them as the fairs of Flanders and Champagne had done. A rotation embracing the two fairs of Leipzig, the two fairs of Frankfurt on the Main, the fairs of Naumburg and Frankfurt on the Oder provided a continuous market. However, the business of the German fairs in transit trade and exportation was more limited than that of the old French fairs; as contemporary writers say, they were especially import fairs, *Einfuhrmessen*.

At last, in the nineteenth century, the German fairs declined in their turn, giving place to the Russian fairs. The Russian fairs, which date only from the close of the Middle Ages, began to attract large gatherings in the fifteenth century. The fair of Novgorod the Great then figured as the chief me-

17 Richard Bettgenhaeuser: Die Mainz-Frankfurter Marktschifffahrt in Mittelalter (Leipziger Studien, Vol. 2, No. 1), Leipzig, 1896. Henri Estienne: Francofordiense emporium, sive francofordienses nundinae, Geneva, 1574.

18 Ernst Hasse: Geschichte der Leipziger Messen, *Preisschr. Fürstl. Jablonowski'schen Gesell. zu Leipzig, No. 25*, 1885. Philippi: Die Messen der Stadt Frankfurt an der Oder, Frankfurt on the Oder, 1877.

dium for the distribution of German merchandise in Russia and Asia and of Asiatic goods in the Russian and the Baltic countries. Fairs had long been held at various points in the debatable ground between Slav and Asiatic. The most important of them seems to have been held since the ninth century in various places, first on the banks of the Volga at the confluence of the Kama and then at Kazan. Finally in the first half of the seventeenth century, owing to the great concourse of pilgrims to the old established monastery of Makariev, the fair was settled at this point, about 40 miles from the confluence of the Oka and Volga, at a date just before the feast of St. Macarius (September 5). In 1817 it was moved to Nijni Novgorod at the actual confluence,[19] where it has flourished up to the present day. It has been customary to hold the fair for four to six weeks a year from the 15th of July (Old Style) to the 25th of August officially and in fact to September 10 (Old Style). It was visited annually by some 200,000 persons and had a turnover of hundreds of millions of rubles (246,000,000, the maximum, in 1881). This famous fair has held an exceptional position as the place of exchange between Europe and Asia. There were brought together all objects of commerce; but cotton goods, skins, furs, and tea from China held the first place. Other well-known Russian fairs include those of Riga, Archangel, Kharkov, and Kiev; and there are numerous Russo-Asiatic fairs in Siberia and Central Asia.

The same epoch that saw the Russian fairs flourish saw also the development of fairs in Asiatic Turkey and the Balkans, where special note may be made of the fair of Usunji in the vilayet of Adrianople which thrived during a quarter of a century.[20] Finally it may be observed that in Mecca there still exists a fine example of a fair intimately related to an ancient pilgrimage and to caravan movement. The greater part of the native commerce in Africa also, as in the interior of Asia, is still carried on in the form of commodity fairs, and new ones are still being established.[21]

## General Characteristics of Commodity Fairs: Periodicity

Periodicity is the most obvious trait of the commodity fair and that which has been commonly regarded as most fundamental.[22] In reality the periodicities of fairs are very diverse, both as regards relative frequency and seasonal occurrence, an indication in itself that this variation is not according to a rigid geographical rule. The most one can say is that fairs of the fine season predominate. Furthermore, there exist instances of non-periodic fairs—such as are held in ports on the arrival of ships. If the port has a con-

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19 V. Vinogradoff: Les foires, in M. W. de Kovalevsky: La Russie à la fin du XIXe siècle, Paris, 1900, pp. 646 *et sqq.* H. P. Kennard: The Russian Year-book for 1911, for 1912, etc., London. Die Messe zu Nishnij-Nowgorod, Umsatz und Preise in den Jahren 1864–1873, *Russische Rev.*, Vol. 6, 1875, pp. 34–69, St. Petersburg. H. A. M. Butler-Johnstone: A Trip up the Volga to the Fair of Nijni-Novgorod, London, 1875. The question of Russian fairs has been summarized by Édouard Herriot, cited below (footnote 43).

20 Karl Andree: Geographie des Welthandels, 3 vols., Stuttgart, 1867–77; reference in Vol. 1, pp. 54–176.

21 For an example of a present-day establishment of a biennial fair in the Sahara see René Bazin: Charles de Foucauld, explorateur du Maroc, ermite au Sahara, Paris, 1921, pp. 377–378.

22 Huvelin, *op. cit.*, p. 36.

siderable size, Marseilles or Bordeaux for example, or if it is the rendezvous of periodic maritime convoys, as the Hispanic-American galleons in the sixteenth and seventeenth centuries, it may become the seat of "maritime fairs" held at fixed times. In some instances combinations of fairs, as we have seen, fill the entire cycle of the year, merchants and merchandise traveling from one to the other. As a matter of fact, periodicity is rather a superficial trait, a convenient device which conceals a characteristic of much more fundamental importance, described more fully below, *the itinerancy of the traders and their merchandise.*

## Security of the Fair

The charter of the fair always gave guarantees of and assured the privileges of protection. Merchants proceeding to an international fair obtained a kind of special passport, the "conduct of the fair" (*conduit*), which assured them and their merchandise free passage on certain defined routes and during a prescribed time. The great fairs exercised a sort of jurisdiction along the routes of travel even in foreign countries. The chiefs or wardens of the fairs of Champagne in the thirteenth century intervened on behalf of their merchants in Lorraine, Provence, and Italy, and obtained satisfaction.

## International Character of the Fair

At the fair itself the same guarantees of security were offered by the "peace of the fair." Under its aegis commercial transactions were carried on even by merchants of enemy nations. Currency of all nations was in circulation; there was a money exchange and even rudimentary forms of money-order clearing. Generally each nation had its warehouses and inns, just as may be seen today in the *fonduks* of the countries of Arab speech.

In every epoch it was the fairs of the frontiers that flourished best. Those of Champagne near the Flemish border declined when independent Champagne became French, losing its character of a neutral country. Those of Lyons owed their success to proximity to the Swiss and Italian frontiers. This circumstance was indeed taken up as a matter of reproach by their rivals, and an attempt was made to remove the fair to central France, at Tours; but the attempt failed, and the fair returned to Lyons. Like happenings occurred in the history of the fairs of Frankfurt on the Main and Leipzig, and the triumph of Nijni Novgorod over Novgorod the Great is to be explained by the nearness of the former to Asia. In this last instance we return to a highly perfected form of our original frontier commerce, to the origin of the commodity fair and one of its most distinctive traits surpassed in importance only by its essential nomadism.

## The Traveling Merchant and the Fair

To maintain his business uninterruptedly the merchant trader had to travel from fair to fair. He was able to do this by the combination of the

dates and rhythms of the various fairs—this indeed is the chief significance of their periodicity. In the thirteenth century, for instance, the same merchant might be found traveling in Champagne, Flanders, Spain, Italy, and Germany. He carried along with him merchandise bought and sold in the course of his journeys in the measure of his particular interests; he played in some degree a rôle analogous to that of the tramp ship on the ocean today. Sometimes, in consequence of developments in local or general conditions, or because of accidents en route or change of needs, supply would exceed demand, and the fair would be especially favorable to the buyer; sometimes the converse would be the case; but generally, owing to the itinerant character of the trade, supply and demand met. It must, however, be noted that merchandise, in bulk, was transported *before being sold* with the intention of being offered for sale, a fact which perhaps constitutes the chief difference with ordinary commerce of today.

In each of the fairs that he visited the itinerant trader met for the most part the same customers, debtors, and creditors. Thus it became customary to designate the fairs as the dates when accounts fell due. Some fairs were established for the express purpose of serving as a financial offset to others; as, for instance, was the case with the fair of Ríoseco in Spain founded in the sixteenth century in correspondence with one of the four fairs of Lyons, the only one which had not its counterpart in Spain. For the trader constrained to travel the year round the fair was naturally the only place for the balancing of accounts. This was, in later years, much the most important function of the fair of Nijni Novgorod.

Finally the fairs themselves are subject to a sort of migration or displacement. In general they do not prosper for long in the same place. A fair such as that of Leipzig, maintained uninterruptedly through eight centuries, is extremely unusual. Some fairs in fact are not fixed at all; that of Besançon, established in the fifteenth century and chiefly frequented by Italian merchants and bankers, was held successively at Poligny in the Jura, Chambéry in the Alps, and Piacenza, Asti, Novi in Italy, and finally near Genoa. This also was the case with the great Russian fair before its settlement at Nijui Novgorod as has been described above. The fair is only accidentally connected with a town and because it finds there temporary advantage. An organ of itinerant trade, its fate is in no wise related to that of the fixed organism, the town.

## Location of Fairs

It is unnecessary to dwell on the fact that the great fairs have succeeded because of their situation on great highways of communication. A map showing a country's fairs at the time of their apogee will show them on the great trade routes of the time. Every fair had its sphere of influence on the borders of which it came in contact with other fairs, and the history of fairs is full of reciprocal encroachments. From the strife between rivals would arise for a time fairs of the first magnitude that in turn would be

supplanted by others, in part from geographical causes but also from political and social developments—changes of boundary or of political régime or diversion of trade currents. Each case requires individual analysis.

Sites of fairs chosen exclusively for reasons of a sentimental order, for example pilgrimages and holy places, are generally inferior to those selected for reasons of material advantage; yet there are instances where the influx of pilgrims constitutes a commercial advantage in itself and where it has made the fortune of an otherwise ill-favored place. Such is more particularly the case in countries where religion figures as a political force—the Mohammedan lands, China, or Christian Europe prior to the Middle Ages.

But ordinarily two classes of circumstances favor the location, for the time being, of the itinerant commerce of the fair. In the first instance selection may be made of the centers of producing regions. Thus the Flemish fairs were essentially the outlet of the seventeen cloth-manufacturing towns which in the Middle Ages made Flanders the first textile region of the continent. The fairs of Lyons assured the sale and provisioning of the industrial centers already scattered over France in the sixteenth century and in particular the two industries then created at Lyons itself, the silk and book trades.

Or again this itinerant trade is fixed for the time being in places of transit and at crossroads especially, as we have seen in frontier regions, for example in Champagne, at Breslau, and the two Frankforts.

When the two circumstances are combined—the producing region and the crossing of great highways—one finds exceptional conditions making the fortune of a Lyons or a Leipzig.

## The Fair of Kiev

It also happens that the fair facilitates exchange and intercourse in a region almost purely rural where the inhabitants have no other opportunity for communicating with the outside world. This is the condition which gives rise to the live-stock fairs, but it has also been responsible for the creation of certain commodity fairs or of the two kinds of fairs in combination. A good illustration is afforded by the fair of Kiev, the so-called "contract fair" or, because of the date (February 5 to 25), the fair of the Purification. There transactions are carried on in cash or in terms of the products of the region—grain, sugar, alcohol, coal, metals; the affairs of the sugar industry are settled for the year; contracts are made for agricultural labor and for the sale and renting of land. It is at one and the same time a local, rural and industrial, and an international fair at which is made historic contact between the Mediterranean and the Slav regions.

## Connection Between Fairs and Towns

Fairs also develop as a natural consequence of nomadism in countries where that is the normal form of life. It may be that no town exists and

the fair is held in the open country. It may be, as at Timbuktu, that the town is only an isolated point of fixed habitation around which centers the nomad life. In such circumstances, and especially in the last instance, fairs may give rise to fixed centers of population or encourage their growth to a marked degree. A town such as Nijni Novgorod which owes everything to its fair and lives almost entirely for it is an exception. When there is superposition of a fair and a town the two institutions are entirely distinct: even at Nijni Novgorod this is true. The fair is a supplementary

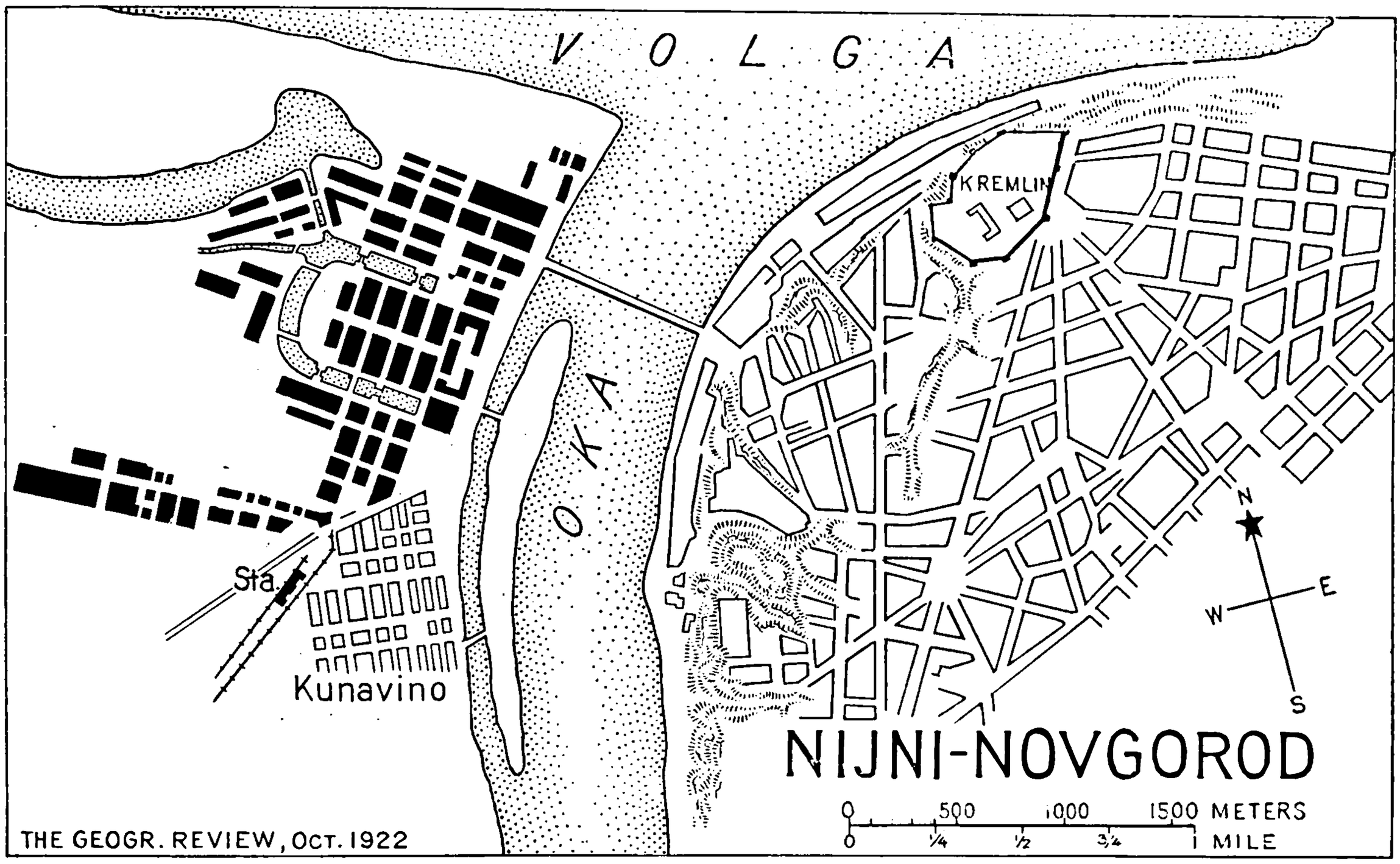


FIG. 5—Nijni Novgorod, the town and the fair. The ground to the east of the permanent buildings of the fair is covered with temporary structures during the period of the fair; the (wooden) bridge across the Oka is also temporary. For a view of town and fair see Figure 3 illustrating the article, "The Economic Resources of the Russian Empire," by E. K. Reynolds, *Geogr. Rev.*, Vol. 1, 1916, p. 254.

town, a parasite in a certain sense, sometimes incorporated in the fixed town for the time but more often existing in juxtaposition. The administration is not the same; the laws of government are different. There is a sort of "right of the fair" to which there is nothing corresponding in the town. A merchant from the town who wishes to engage in trade in the fair must carry thither his goods, and he has no advantage over the stranger.[23]

Furthermore, the fair has its own installations varying greatly in appearance according to the country and time to which they pertain. It may possess edifices of stone although they are only used intermittently, as at Nijni Novgorod where such buildings have a frontage of 1,800 meters, or the ancient halls, *halles*, of the Geneva fairs. There merchants are generally grouped according to commodities, as is done in the *suks* of the Mohammedan towns. In other cases the fair is only a temporary camp hastily erected

[23] Bourquelot, *op. cit.*, Vol. 1, pp. 77 and 324; Vol. 2, pp. 253 *et seq.* Borel, *op. cit.*, p. 92. Brésard, *op. cit.*, pp. 112 *et seq.* Huvelin, *op. cit.*, pp. 76 and 81.

on the eve of its opening on the "fair ground." Then it is composed of tents and huts, such as, for instance, were ranged along the banks of the Saône for the ancient fair of Lyons. On the other hand, the fair may be held in town buildings, public as well as private, as for the most part in the fairs of Flanders, Champagne, and Germany, notably at Leipzig. Or, yet again, the three forms may exist in combination, as happens more particularly in the case of well-to-do fairs.

The fair also has its own personnel and administration. It has its special police and judges, distinct from those of the town, who settle disputes according to the custom of the fair, not of the town. Money dealers, "bankers in the fair," who are not interested in business in the town, regulate the money exchange and the mechanism of credit. Up to our own days the great European banks have been represented in Nijni Novgorod only during the time of the fair. Finally, there is a host of brokers and middlemen whose special business is as old as that of the fair and is rendered necessary by its international character. They are licensed agents holding a legal status whose business is entirely separated from that of the town. A tradition of probity attaches to their transactions, which are carried on with a minimum of written guarantee, often by word of mouth alone. This characteristic is clearly indicated in the fairs of ancient Greece, and one sees it today among the cattle brokers of the fairs of western Europe. Obviously it is a trait of itinerant commerce which cannot be embarrassed with papers and procedures and must live on trust.[24]

These facts explain clearly why great fairs have often been long associated with small towns. This was the case at Beaucaire in southern France near the mouth of the Rhone, at the door of the commercial world of the Mediterranean and the Orient, and similarly at Briançon, the frontier town of the French Alps (altitude 1,326 meters) on the great road to Italy.[25] It was for long the case with St. Denis, at the doors of Paris. Undoubtedly the town derived some benefit from the fair, but less than is commonly thought. It is the town treasury and the inns that gain the greatest advantage; local trade scarcely profits at all. The fair greatly increases the population, but in a purely momentary fashion. It sometimes happens that a powerful town, well-favored in its site and geographical position, creates a fair to add to its renown. Such is the case of Lyons; but the origin of the fair is dissociated from that of the town which gave it birth. The fair is of a nature entirely different from that of the town with which it has only superficial relations.

## Decline of the Commodity Fairs

In the measure in which material civilization perfects means of exchange and communications and assures the commercial world increasing security,

[24] Huvelin, *op. cit.*, p. 74, note 5; André Allix; La foire de Goncelin, *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 2, 1914, pp. 299–334.

[25] Henry Petiot: Briançon: Esquisse de géographie urbaine, *Rev. de Géogr. Alpine*, Vol. 9, 1921, pp. 341–456. Grenoble.

the conditions which rendered necessary the expedient of the commodity fair progressively disappear, and the fairs must decline or suffer transformation. We have, for instance, a contemporary example in the decline of the fair of Irbit since 1885, the date of construction of the railroad from the Urals. International traders cease to frequent the fairs in person, employing representatives or "factors" and finally abandoning them completely to retail trade. Monetary transactions are carried on more and more by permanent exchanges and clearing houses. Merchandise is shipped only on order; sales are made on sample, and it is no longer necessary for buyers and sellers to meet before the actual goods. The system of fairs is superseded for wholesale trade. Large-scale commerce has become rooted in permanent centers between which in all directions and at all seasons travel individuals, samples, and uninterrupted currents of correspondence and goods.

Yet the immediate effect of this fixation of commerce is not to diminish the *number* of fairs. On the contrary, as their importance declines their number increases. As the great international fairs disappear, little local fairs arise; in the last two centuries France has been sprinkled over with them, but many have only an ephemeral existence. They tend to degenerate into mere periodic amusements. Thus over the greater part of France the popular merrymakings whose commercial rôle is practically *nil* still bear the name of fairs.

While waiting for modern means of communication to penetrate to the corners of the country the "superannuated medium"[26] of the fair may, however, still find justification in turning from general to local trade. But even under this form it is condemned to disappear sooner or later except as it may survive by adaptation to certain specific categories of trade. Thus is transition made to specialty fairs.

## Specialty Fairs

Certain decadent fairs long preserved a national or international rôle for certain forms of exchange. Some retained simply a financial function, liquidating accounts incurred elsewhere, as was the case with the vagrant fair of Besançon mentioned above: it was also one of the aspects of the fair of Leipzig in its period of decline, at least as regards the book trade. In other cases the degenerate fairs deal only with special articles of commerce produced or collected in their region; such were the ancient fairs of Caen in Normandy, which sold nothing but linen; those of Leipzig thirty years ago, which then specialized almost exclusively in furs and books. One might also mention the Polish fair of hops in Warsaw (September 13–17), the fish, oil, and down fair of Archangel, the fair of fats at Ischin in the government of Tobolsk. Specialty fairs can maintain themselves for a long time; in a quarter of Paris there is still held about Easter the "Old Iron Fair," or "Ham Fair," as it is also known from the featuring of that product in addition to old metal goods. The "Gingerbread Fair" is another popular old survival.

[26] "Intermédiaire suranné" according to the expression of M. Herriot (see footnote 43).

Specialization is particularly adapted to commerce in the rarer commodities for which there is a seasonal sale and which cannot be bought by sample. Furs, products of a typically nomadic occupation, offer a good instance in point. Until recently fur dealers frequented the Russian and Asiatic fairs, and such fairs as that of Irbit still do an important business in furs. Furthermore, the big fur markets of Europe and the newly established fur sales of New York and St. Louis[27] have the essential characteristics of the fair. In France a fair of small common furs is still held in the Jura towards the end of winter. Before the opening of the Suez Canal the teas of China, the commerce in which was related to the caravan trade in Central Asia, were largely sold at the Russian fairs, especially that of Nijni Novgorod. There is, however, one product which lends itself in a peculiar degree to the conditions of sale offered in the fair; this is live stock, and the stock fair still flourishes in western Europe.

### Live-Stock Fairs

Many fairs that today deal only in cattle figured as commodity fairs two or three centuries ago. This fact is definitely known in certain instances; for example in France at Guibray (a suburb of Falaise) in Normandy, Autun; and Briançon.[28] Yet it must not be concluded that the present fair is a direct derivative of the old fair. In the instances cited the commodity fair with a more extended sphere of influence and greater variety and historic prestige has simply masked the contemporary existence of the cattle fair, though the latter in fact is probably still more ancient. This appears to be true as a general rule. Though the two forms may coexist they pertain to two different orders of conditions and, as will be shown, are fundamentally distinct.[29] There appear to be cases where in the same town at the same epoch separate cattle fairs and merchandise fairs have been held at different dates. Thus at Grenoble there is today an amusement fair held twice a year, for fifteen days each at Easter and in August, which twenty years ago was a little commodity fair. A cattle fair is held in the same town but in a different location and on different occasions. No trace of any connection between these two kinds of fairs is to be seen today. In the twelfth-century fairs of Champagne there was held once a year along with the general commodity fair a live-stock fair specially devoted to cattle, horses, and mules. In the archives of ancient Dauphiné the writer discovered that in Bourg d'Oisans between Grenoble and Briançon on the road to Italy there were held at fixed times every year about the end of the Middle Ages a general commodity fair and a local live-stock fair.

### Town and Country Markets and Live-Stock Fairs

Primitive rural industry sells its surplus products intermittently, for the countryman who is occupied the greater part of his time on the land has

[27] See note on "Recent Growth of the Fur Trade in the United States," *Geogr. Rev.*, Vol. 5, 1918, p. 145.

[28] Petiot, *op. cit.*

[29] J. G. Bulliot: La foire de Bibracte, *Mémoires Soc. Éduenne*, Vol. 7 (N. S.), 1878, pp. 1–82. Autun.

little time to devote to commercial transactions. By its nature, too, agricultural exploitation imposes intermittency on commercial gatherings, which for reasons of convenience are most often made periodic. The rôle of the fairs of Kiev in rural commerce has already been cited. Where a sedentary agricultural population is concerned, these gatherings can be held at frequent intervals; the interval will be modified if an element of pastoral nomadism is introduced. Thus according to the progression of the seasons and the movements of the herds these gatherings attain a particular importance at certain seasons of the year. The best field for the present study of this phenomenon is furnished by the Islamic countries, notably of northern Africa where, as Jules Blache has recently shown, sedentary agriculture and pastoral nomadism[30] almost everywhere exist side by side. There the places where the country folk foregather bear the names of the days of the week and in succession provide for all the countryside.

Such rural gatherings, at the beginning held almost always in the open country, tend to become fixed centers of habitation. It is a commonplace that one of the reasons determining urban settlement is the concentration of agricultural exchange in the form of a "country market." But, in the measure that the town thus created develops, it begins to acquire its own proper functions. It ends by itself absorbing all the country products for which it has been the seat of exchange. Thus arises the city market without which the city cannot live. Zola gives us the study of a formidable contemporary example in "Le Ventre de Paris." Each city is surrounded by an area more or less extensive whose activities are almost exclusively devoted to supplying its sustenance, a fundamental element in any study of urban geography.[31]

Under the form of the city market rural commerce has only the most distant connection with fairs. In most of the towns of Europe markets and fairs are entirely separate and distinct phenomena, though, as we have remarked, they have a community of origin in the periodic gathering for the disposal of surplus agricultural produce. The market is closely bound to the town which it serves; the fair has only relations of tradition or convenience; it does not function for the town's sake, only for the surrounding country.

The distinction that we make would perhaps seem to be factitious did there not exist examples of the initial juxtaposition of market and cattle fairs in the same town and before their dissociation. There is the instance of the majority of the Islamic towns where, as we have said, the introduction of live stock at certain dates—which constitutes the fair properly speaking—heightens the activity of the market. Best of all is this demonstrated in ancient Rome.[32] There from the earliest times were held periodic country markets, *nundinae*, so called because held every nine days. The *nundinae*

[30] Jules Blache: Modes of Life in the Moroccan Countryside: Interpretations of Aerial Photographs, *Geogr. Rev.*, Vol. 11, 1921, pp. 477–502.

[31] Cf. Raoul Blanchard: Grenoble: Étude de géographie urbaine, 2nd edit., Paris, 1912.

[32] At Rome there were besides the *nundinae* fairs (*mercatus*) properly so called which were held biennially. They were associated with religious festivals; but their importance was completely eclipsed by that of the *nundinae*, which in fact really usurped the rôles of the cattle fairs and commodity fairs. (Huvelin, *op. cit.*, pp. 82–99.)

not only provided a sustenance market for the city; they also acted as the center of the cattle trade of Latium. The regulation of the market, its special juridical features, its locus in the city where each class of merchandise was sold in its proper quarter[33] are all features containing in germ the geographical characteristics of the live-stock fair as we shall analyze it later. As in the cattle fairs, there was added a minor trade in various small wares; and this at certain epochs seems to have developed into a veritable little commodity fair. In the Middle Ages, in fact, the term *nundinae* was currently used to designate the fairs for the sale of both merchandise and cattle; it was more frequently employed than *feriae*. The Roman *nundinae*, then, were a kind of combination of the three commercial institutions, the market, the cattle fair, and the commodity fair.

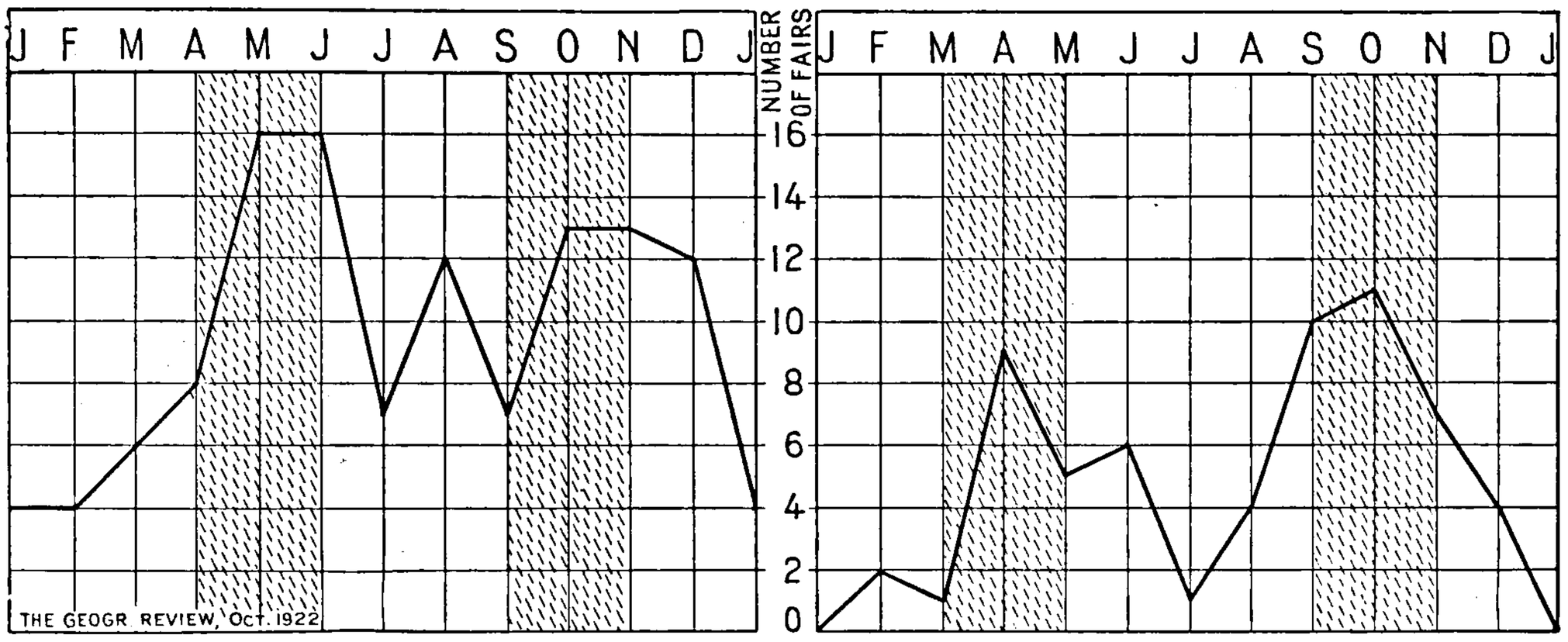


FIG. 6—Graphs showing the rhythm of country fairs in two regions of the Western Alps; on the left in the *département* of Isère (from data by A. Allix), on the right in the region of Pinerolo, Italy (from data by G. B. Roletto). Months when the herds are moved to and from the upland pastures are shown by shading.

## CONNECTION BETWEEN THE STOCK FAIRS AND PASTORAL LIFE

The pastoral industry is of all forms of exploitation of the earth that which most imperiously exacts movement from place to place, that is to say nomadism. Now it is exceptional that nomadism is purely capricious. Almost everywhere it takes place within definite limits, more or less extensive, and brings the herds and their guardians to definite places at fixed times. There are in Central Asia and the Sahara examples of pastoral nomadism of very long period, in the mathematical sense; in Europe today the periods, the distances, the forms even of this nomadism are infinitely varied; but it always exists in more or less definite form.[34]

[33] The division into commercial quarters or *suks*, under diverse forms is classic in the towns of the Middle Ages and today in the towns of Islam. At Rome there was the *forum boarium*, the *forum pecuarium*, *suarium*, *pistorium*, *vinarium*, *olitorium*, *piscatorium*, *cuppedinarium*, etc. Compare the localization in the commodity fairs and in the cattle fairs and sample fairs of today (discussed below).

[34] For various local examples in various countries see André Fribourg: La transhumance en Espagne, *Ann. de Géogr.*, Vol. 19, 1910, pp. 231–244; Philippe Arbos: La vie pastorale dans les Alpes Françaises, Grenoble and Paris, 1922; René Musset: The Geographical Characteristics of Western France, *Geogr. Rev.*, Vol. 12, 1922, pp. 84–99. From this point of view a special interest attaches to the last work cited, for it instances, in a non-mountainous region and under present-day conditions, the migrations of live stock to great distances in response to present physical necessities as much as to custom.

Without exception the rhythm of pastoral nomadism is governed by the rhythm of the seasons. The manner of adaptation to the seasons varies, but it is always nature which commands. Pastoral movements are much more rigorously controlled than those commodity movements of which we have spoken under commodity fairs. For the one it is a simple convenience, for the other a necessity.

In pastoral nomadism the fair appears as an element of permanence. Accustomed to pass at fixed intervals in the neighborhood of the same points, the driver of a herd knows that he will meet there drivers of neighboring herds. The meeting provides a temporary arrest of nomadism. It permits the exchange of animals, the making of contracts for the engagement of herdsmen, for the combination and composition of the herds, and for the sale of pastoral produce. Thither come also those people from the exterior who wish to buy cattle. The cattle fair is the rendezvous for the butchers of the towns, sedentary cultivators who wish to lease cattle, cattle dealers. For the industry of the pastoral region it is the sole commercial outlet; and for the exterior the sole economic contact with the pastoral region. For the pastoral people it is, furthermore, the opportunity to buy other products of which they have need. It is for this reason that the cattle fair is almost always accompanied by the sale of a certain amount of general merchandise and is attended by a host of itinerant retail traders. Sometimes these are merchants with an established place of business who take advantage of a near-by fair, but most often they devote themselves solely to itinerant trade,

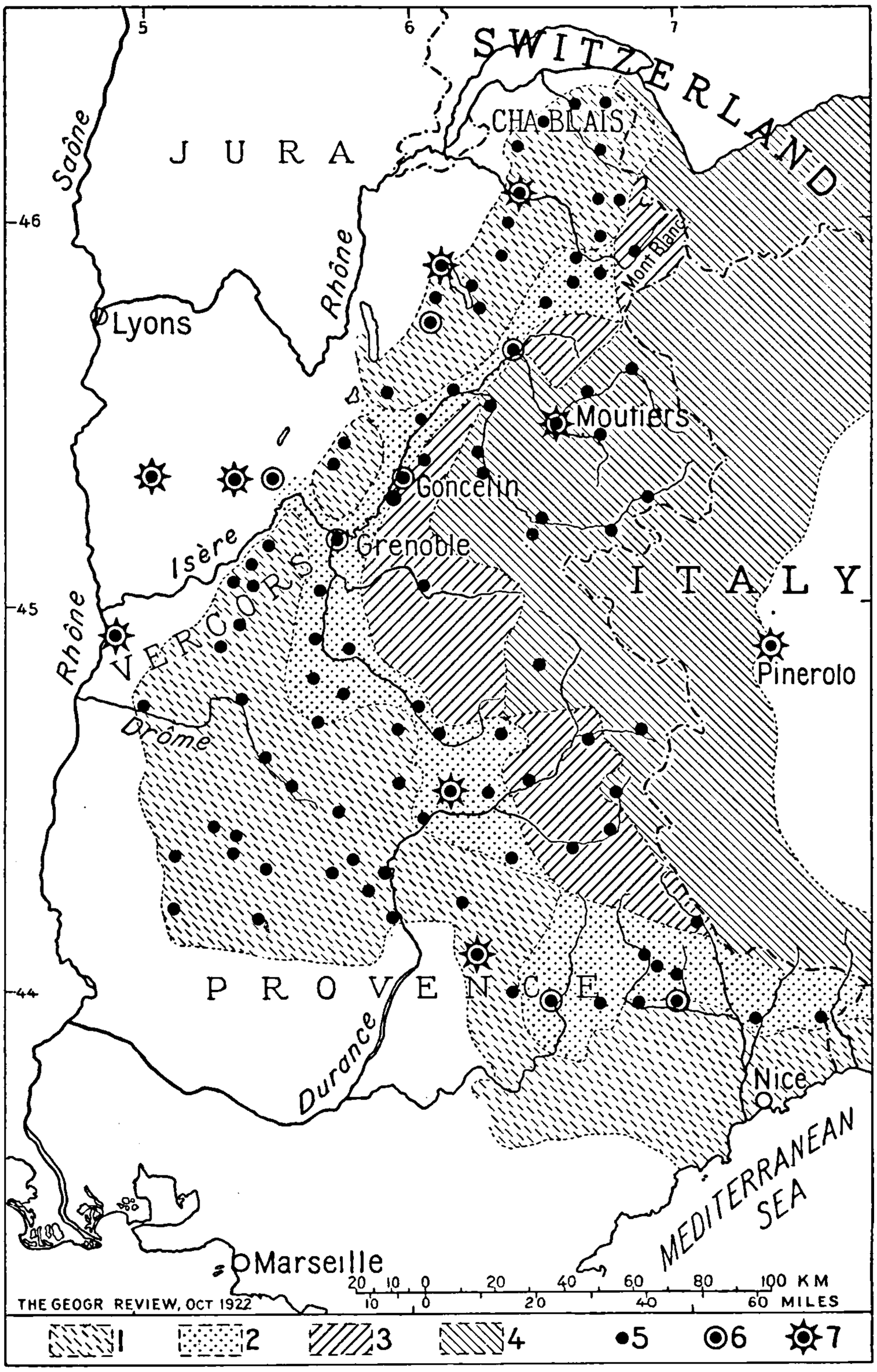


FIG. 7—Live-stock fairs of the French Alps (chiefly after Ph. Arbos). The numbers have reference: 1–4, natural regions; 1, pre-Alps; 2, sub-alpine depression; 3, central massifs; 4, intra-alpine zone; 5, fairs; 6, especially important fairs; 7, the great fairs exporting outside the Alps.

passing continually from one fair to another over the entire region. In this humble form alone does the cattle fair resemble the commodity fair and exceptionally is a degenerate derivative from it. Between the rhythm of the fairs and that of pastoral nomadism is an indissoluble connection. An attempt to change the traditional dates of fairs at the time of the French Revolution had quickly to be abandoned. However, in some non-mountainous regions where pastoral nomadism does not exist today there are fairs without apparent seasonal connection. For example in the Garonne basin fairs are generally held once a month. But even here the Spring and Autumn fairs if not more numerous are far more important as far as live stock is concerned.

## Live-Stock Fairs in the Western Alps

It is from the western Alps that we shall select some present-day examples of live-stock fairs. It is true that this region is not the only one in the Old World where the institution keeps its importance nor even that where it is most widely developed or most generally known, but it is here perhaps that pastoral nomadism is most characteristically defined and presents the clearest relations with the mechanism of the fairs (Fig. 7). Furthermore it is the only one in which the requisite geographic studies have been carried out in detail. The following discussion will be in essence a résumé from three recent works—on the pastoral life of the French Alps as a whole by Philippe Arbos,[35] on the French fair of Goncelin by the author of the present article,[36] and on the Italian fair of Pinerolo by G. B. Roletto.[37]

We have already remarked on the close connection between the monthly frequency of the live-stock fairs and the movements of the herds (Fig. 6). In the winter the stabled animals are fed on hay gathered during the preceding season. For the cattle industry this was long a dead season during which the animals were merely kept alive and from which they emerged in great need of fattening on fresh pastures. Great progress has been made in recent years, however, in stall feeding; and it is not uncommon for animals at the end of the winter to be ready for immediate sale. It is in regions where this stall feeding is practiced that the fairs are held the earliest—even before Easter.

In spring the herds are made up to go to the "mountain" or "alp" for the warm season—a business for which the fairs are an almost indispensable medium since the owners must place in common keeping their beasts and their interests. In general this is the period when fairs are most numerous. In the southern section of the Alps, the sheep country, where spring is earlier, the time of the greatest number of fairs is April; in the northern Alps, the cow country, it is May and June.

While the herds are summering on the mountain—"les montagnes sont garnies"—there is a diminution in the number of fairs, especially in the sheep

[35] See footnote 34.

[36] See footnote 24.

[37] Le condizioni geografiche delle fiere di Pinerolo, *La Geografia*, Vol. 9, 1921, pp. 99–135.

FIG. 8

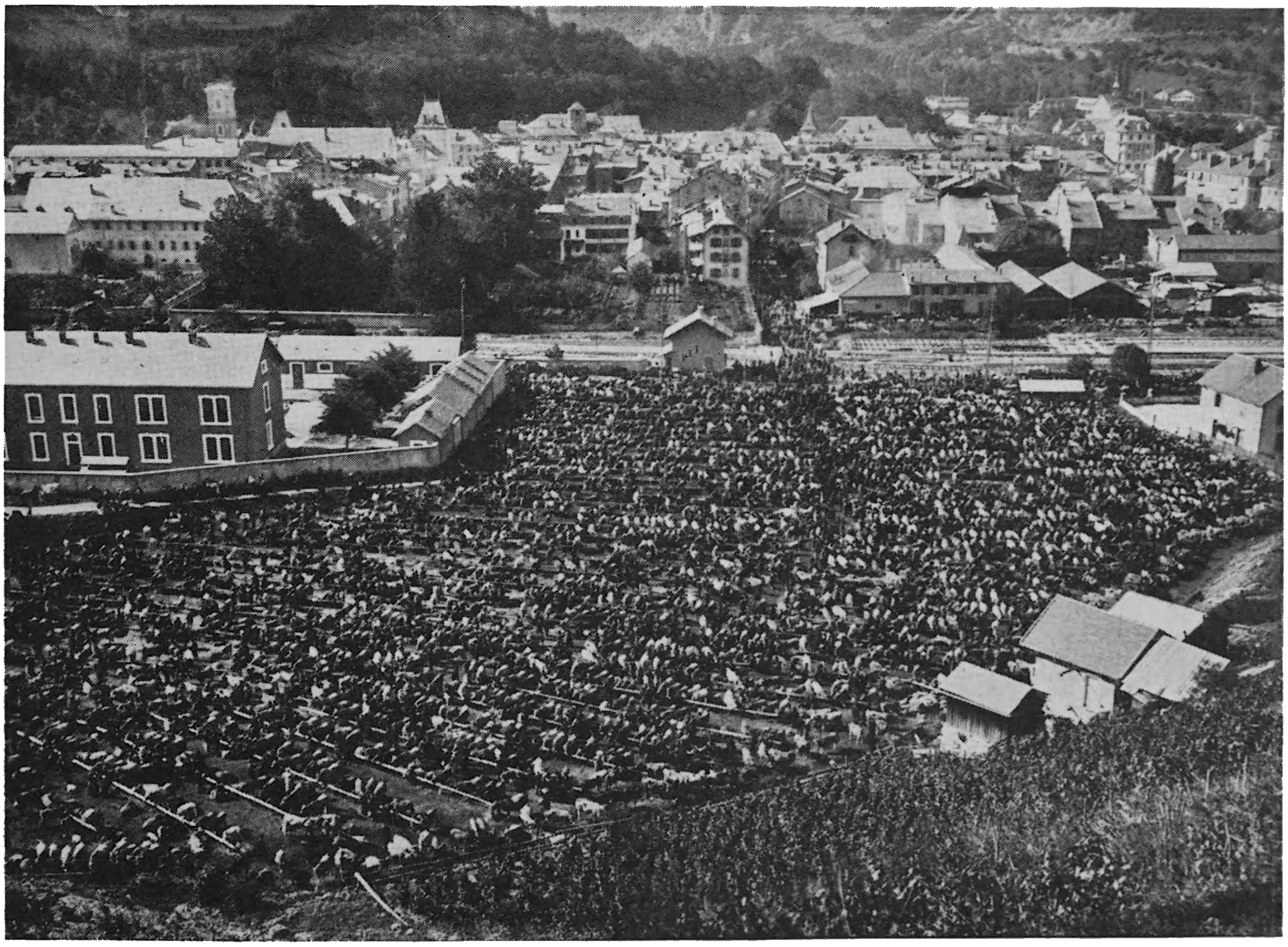

FIG. 9

FIG. 8—The live-stock fair of Autun, Central Massif. (Photograph by courtesy of E. Guignard.)

FIG. 9—The September live-stock fair of Montiers-en-Tarentaise, Savoie. (Photograph by Raoul Blanchard, reproduced from Fig. 27, in Ph. Arbos: La vie pastorale dans les Alpes françaises.)

country. In the cow country summer fairs are held for the sale of dairy produce, the chief agricultural wealth of the Alps. Sale of cheeses is the more necessary as that product is the common currency with which communes or individual proprietors are paid the rent of the mountain pasturages.

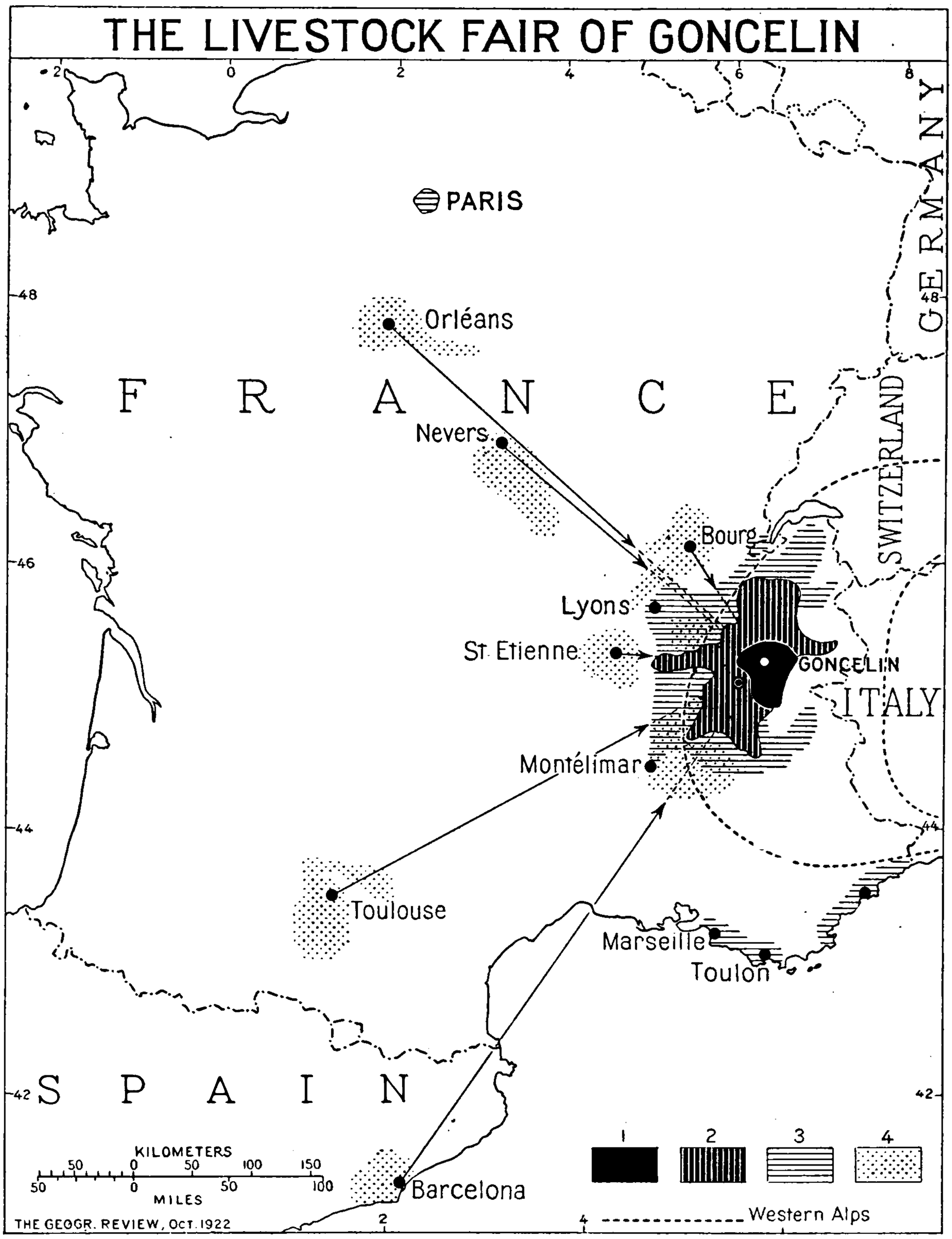


FIG. 10—The economic sphere of the live-stock fair of Goncelin. The numbers have reference: 1, economic domain, or *umland* of the fair; 2 and 3, regions supplied by the fair with cattle and sheep—2, regions regularly supplied by direct exportation (the circle herein is Grenoble); 3, regions supplied irregularly and by the intermediary of other fairs (re-exportation); 4, regions supplying the fair's import of pigs.

In autumn, sometimes from the end of August, the beasts begin to descend well-conditioned for slaughter; it is again a period when fairs are particularly numerous for the pastoral folks then wish to liquidate the expenses of the summer period and realize their profits. The fairs of this season are in general the most important of the year. At the big Savoyard fair of Moutiers-en-Tarentaise, for example, some 4,000 to 6,000 head of cattle are

assembled each September (Fig. 9). The season terminates in October or November in the warmer regions of the south by some big sheep fairs before the period of winter stabling is begun or the winter migration of sheep takes place towards the sunnier regions of Provence.

Figure 7 shows all the centers of the French Alps where live-stock fairs are held at least four times a year or where they have a recognized importance. It will be noted that they are ranged in the largest number among the chief highways traced by nature and the roads leading to the great Alpine passes; then in the natural regions[38] whose own products play an accessory part in the trade of the fairs (the rich agricultural country of the sub-alpine depression; and Vercors and Chablais, regions producing breeds suitable for the mountain); then the great valleys of the intra-alpine zone, the country *par excellence* of summer pasture outside the Alps. In all these regions the herds still travel on the hoof for the most part, the railroad is only used for exportation outside the Alps. In this respect the entire country of the French Alps presents the characteristics of an economic unit.

## Two Examples in Detail: The Fairs of Goncelin and Pinerolo

The great fair of Gresivaudan, held at Goncelin probably from the end of the Middle Ages, is the pastoral center of a little economic domain in the interior of the French Alps. We say advisedly the fair and not the town of Goncelin; for the town has no connection with the pastoral business other than to give asylum eighteen times a year to the gathering of stock raisers and their beasts, the cattle dealers, and the itinerant retail merchants. The fair is held every Saturday in May and June, on the 10th and the 25th of August, and again every Saturday in November and December. In regard to its economic domain the rôle of the fair is triple. First it centralizes the exchanges made in the interior. The beasts here pass from one owner to another, and here are drawn up contracts for summering and for rent of the mountain pastures. In the second place, the fair concentrates the animals destined for exportation outside the region. And thirdly, and this aspect is perhaps a little unexpected, it is a medium of importation for the region. There is, in fact, one kind of live stock that the region does not raise but which it consumes in quantity, that is the pig. Every countryman fattens one or two pigs for home consumption, but he buys the animals young at the fair, and should he have more than he needs he sells his surplus there. This rôle of importer and exporter is analogous to that played by a port in respect of its *hinterland;* and it was this fact that led the author in 1914 to propose the term *umland* to designate the economic domain of the fair.[39]

We now turn to the fair of Pinerolo, of which M. Roletto has given us an

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[38] See Raoul Blanchard: The Natural Regions of the French Alps, *Geogr. Rev.*, Vol. 11, 1921, pp. 31–49.

[39] M. Roletto (*op. cit.*, p. 134) does not see the necessity for this new term and prefers "economic domain," which, however, is not only longer but less precise; *umland* has specific reference to the commercial balance of exchange with the exterior and with it is associated the idea of "land" port.

excellent picture in his thoroughgoing study. Pinerolo is situated where one of the most important systems of converging valleys of the Piedmontese Alps opens on to the plain. One of these valleys, the Val Cluson, is the age-old route from the Piedmont to Dauphiné by the pass of Mont Genèvre, and Pinerolo was up to the nineteenth century a point of departure and arrival of international traffic. Towards the mountains the *umland* of the fair is limited by the French frontier and by the crest defining the confluent valleys. On the plain, where there is neither natural barrier nor international boundary, delimitation is less clear; and here the commercial attraction of the great center of Turin makes itself felt in constantly increasing degree.

The fair of Pinerolo, like that of Goncelin, dates from the end of the Middle Ages: its charter was granted in 1433, and it was held for the first time in 1450. It has, however, suffered changes in which may be traced political and economic influences. At the beginning exclusively pastoral, it was held in April and November—spring and autumn fairs of standard type. Later boundary changes increased the sphere of the fair (the change of 1713 was to Italy's advantage; further north, in 1860, a change was made to the profit of France) and led to improvements in the agricultural production of the region, especially on the Piedmont plain; and growth of industry in the town of Pinerolo contributed to its progress. In the nineteenth century the date of the autumn fair was progressively advanced until it ended by being held in August. Today the dates of the fair are the last Monday, Tuesday, and Wednesday in April; the last Tuesday and Wednesday in August. By a coincidence which is relatively rare the August fair corresponds to the festival of the patron saint of the region. The fair today has a mixed character, agricultural and pastoral, but trade in live stock is dominant. Grains—wheat and maize—are also commercially important; but—and this shows the fundamentally pastoral character of the fair—they are sold at the weekly market with its more limited scope rather than at the fair where the important sales are in cattle, horses, mules, and pigs.

For cattle the fair of Pinerolo plays the part that we have already described in the case of the Goncelin fair; it brings together the stock of the region, regulates the local nomadism, and furnishes export material. The greatest buyer is Turin. For other kinds of stock it functions rather as an importer, for there is no breeding center in the region. Here its sphere extends to the Abruzzi, to Touraine, and to Hungary (Fig. 11). In addition it has a more important rôle as a distributing agent than Goncelin. The pigs imported, like those of Goncelin, are distributed throughout the economic domain; but these limits are considerably passed in the case of horses and mules, in fact it may be said that the entire upper basin of the Po obtains from the fair of Pinerolo its requirement in these animals, the horse for the plains, the mule for the mountains. The spring fair of Pinerolo is perhaps the most important mule fair in northern Italy. Even for cattle the rôle of the fair of Pinerolo appears to surpass that of Goncelin. Within its economic

sphere are other local fairs which effect a preliminary concentration of the cattle destined for sale outside the region. These are then brought to Pinerolo where they are bought by outside dealers who thus are saved the trouble of visiting the local fairs. Pinerolo might be described as a fair of second (or superior) degree, a characteristic which M. Roletto has not pointed out, though it appears to the writer a distinguishing feature. In the French Alps there are several great fairs of the same kind, which collect for

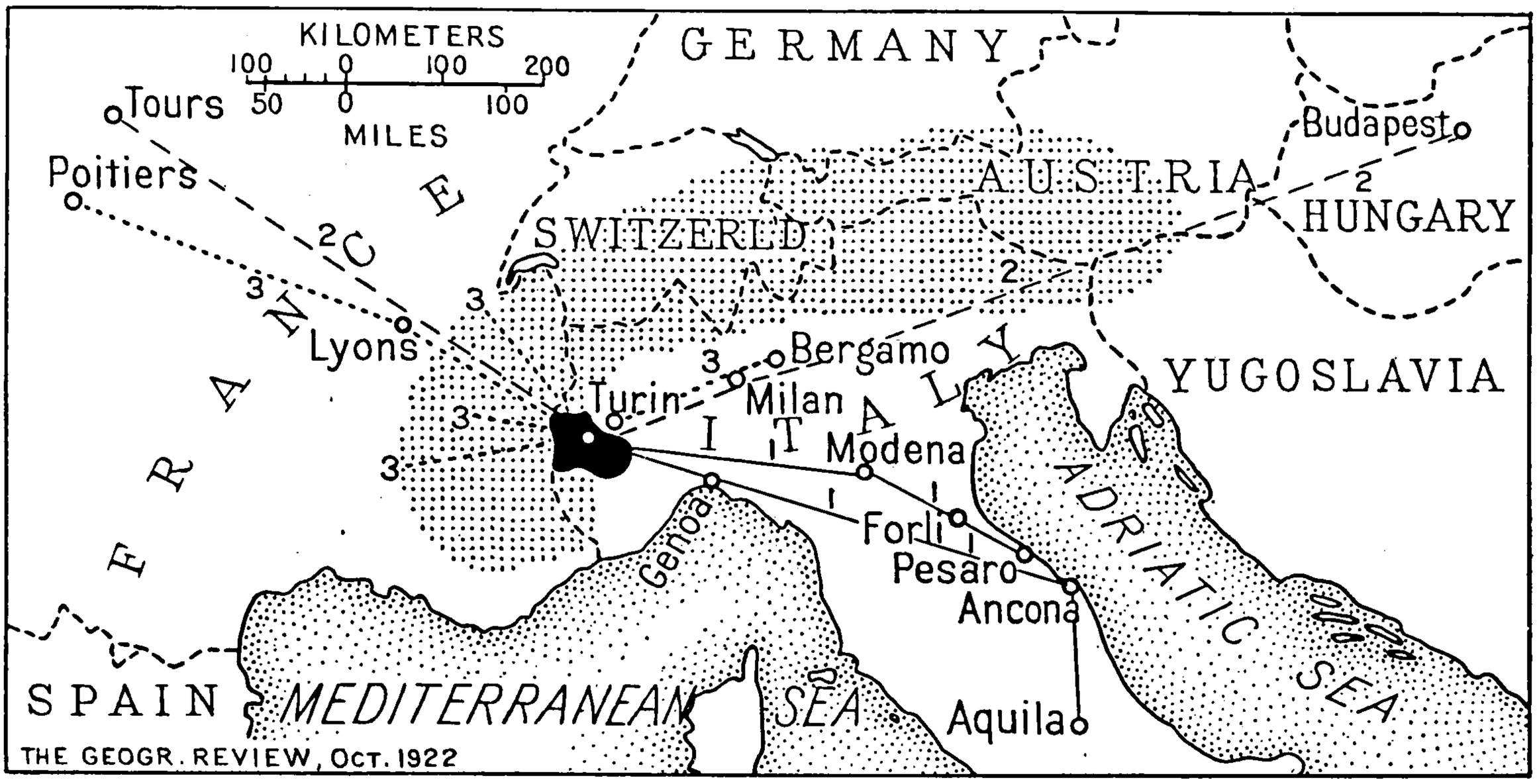


FIG. 11—Map showing the sphere of influence of the fair of Pinerolo, Italian Alps (after G. B. Roltteo). The area of the Alps is approximately indicated by shading; the economic domain of the fair is shown in solid black; the numbered lines show origin of (1) pigs, (2) horses, (3) mules brought to the fair from without the economic domain.

export from the local fairs and are frequented by dealers who supply every section of France.

## PRESENT-DAY DECLINE OF THE STOCK FAIRS

At the present time we are witnessing a somewhat rapid transformation of pastoral industry in the Old World. The rhythm of nomadism, while yet respected, is no longer of vital importance. The stable is no more a temporary makeshift but a place for the fattening of stock for the market. In some places the summering on the mountains has been given up altogether, as, for instance, in the humid massifs of the pre-Alps where around each village is plenty of grass for the entire year. Transhumance of the flocks of sheep from Provence to the Alps and vice versa is also on the decline. At the same time the fair whose *raison d'être* is pastoral nomadism is progressively losing its age-old importance.

Live stock has gained in value, is more sought after, and at greater distances and more regularly. The phenomenon is general, but it is very clearly apparent in the French Alps where the introduction of modern means of communication has been relatively late and abrupt. A more extensive

clientele demands a more regular supply, which the system of fairs, essentially intermittent, does not furnish. Purchases are made daily. The fairs, it is true, are sufficiently numerous and uniformly distributed over the entire area of the pastoral country to guarantee at least one at every season of the year, but their inequality in magnitude is unsatisfactory to the dealers; only the big fairs of spring and autumn are adequate in this respect, and at these the competition between buyers is more and more keen.

There is, furthermore, a constantly increasing tendency for the buyers of pastoral products, both stock and dairy produce, to travel the mountains at all seasons and purchase direct from the producers. Live stock and dairy produce bought in such way travel at all seasons by road and rail. As the countryfolk say, trade is done less and less at the fair and more and more "on the road." The buyers seek to get ahead of one another and strive in particular to obtain the best of the stock some days before the fairs. Hence the fairs tend to be neglected both by buyers and producers. There are entire regions where this commercial vehicle, but lately important, has now fallen into complete disuse; as, for instance, is the case with Trièves to the south of Grenoble.[40]

Decline is overtaking the stock fairs of the Old World as it has overtaken the merchandise fairs, but more slowly and more recently. Must one conclude, then, that they too will sooner or later fall into complete decadence? We do not think so. It must be recalled that cattle are bought individually rather than in the bulk. Undoubtedly if buying is done by the entire herd, as is commonly practiced in the New World, direct control at the moment of purchase is as little necessary as in the buying of corn by the sack or coal by carload. But in Europe stock-buying is seldom done this way. Even if reduced to a secondary commercial rôle, the cattle fair must long survive as affording the best way of inspecting all the cattle of a region with a view to purchase. Furthermore, the stock raiser is not a professional trader, as is the cattle dealer, and can give only a limited portion of his time to the business of buying and selling; he will always have need of the fair to meet his neighbors and examine their beasts, and inter-regional exchanges will always be made there for the greater part. The opportunity for intercourse is an important function of some fairs of today; as the people say, one sees there "many people and few beasts."

The diminished element in the fair is the commercial specialist who, carrying on his business over a great area and varying it according to the interest of the moment, escapes the local geographic limitations. Yet it must be observed that he does it only at a price—by constant travel, fatigue, and additional expense. In contrast the stock fairs offer a positive convenience, and it is not impossible that they will survive, at all events for trade in cattle and beasts of burden, because of the economy they effect in movement and effort.

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40 Charles Robequain: Le Trièves: Étude géographique, *Rev. de Géogr. Alpine*, Vol. 10, 1922, pp. 5–126 Grenoble.

It is an attempt to realize a precisely similar economy in trade in general merchandise that has led to the revival of the old system of commodity fairs under the form of sample fairs. The success of this enterprise shows that it corresponds to a real commercial utility, and it is this same utility that, in conjunction with the permanence of geographic factors discussed above, leads the writer to believe if not in the future growth at least in the persistence of the stock fair.

## The Sample Fairs

### Origin: The Fair of Leipzig[41]

During the course of the nineteenth century the fair of Leipzig entered on a progressive decline. Towards the end of the century it had become almost entirely specialized in furs and books, with the tradė in these tending to desert the fair and become established in permanent quarters in the town. It also had to enter into competition with other fairs of powerful scope held at Berlin.

About 1897 there was taken in the history of the Leipzig fair, and in consequence in the history of international fairs in general, a decisive evolutionary step from which there arose a type of commercial organ adapted to modern life. It was—and the fact is sufficiently rare in geography to merit note—the result of deliberate human initiative, the actual creation of a permanent new fact.

The new tendencies of the Leipzig fair made a tentative appearance in 1890 and were elaborated to definite form in the succeeding six or seven years. The object was to preserve the wholesale trade of the fair and prevent degeneration into a local retail fair, as had happened to its former contemporaries and rivals. Manifestly the old system was incompatible with direct sales in bulk; and the idea of sale with immediate delivery was abandoned. The goods themselves were not brought to the fair; the old-time warehouse of the fair disappeared. Visitors and buyers were offered only *samples* of merchandise; orders were taken to be executed at contracted times; merchandise was dispatched from seller to buyer without passing through the fair. The fair then took on the aspect of an exchange for commercial orders, though temporary and periodic. Broadly advertised, it was also able to draw together interests from a very wide area.

By the circumstances from which it arose the new fair of Leipzig was at the beginning closely connected with the economic life of its immediate surroundings. It called for the exhibition of manufacturers' samples, and the only manufacturers who were directly interested in establishing the new system at Leipzig were those of which the town was the commercial center—Saxony, Thuringia, and Franconia. It was the manufacturers of these three

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[41] Léon Arqué: La foire de Leipzig à l'époque actuelle, *La Science Sociale*, June, 1910, pp. 13–96. Paris. Die Technische Messe, Leipzig, 1921. Charles Touzot: Une visite à la foire de Leipzig, automne, 1921 (unpublished archives of the Lyons fair). Personal information. See footnote 43.

regions who at the beginning founded the union of merchants directing the fair, *Verband der Messkaufhäuser*, an association in which the Saxons (but not the people of Leipzig) naturally dominated. These regions produced a variety of products; the metallurgical products of the Erzgebirge, the mechanical constructions, textiles, and industrial products of Chemnitz, Zwickau, and Plauen; the glass and scientific apparatus of Jena; the hardware, edged tools, and light hardware of Franconia and Saxony; the innumerable

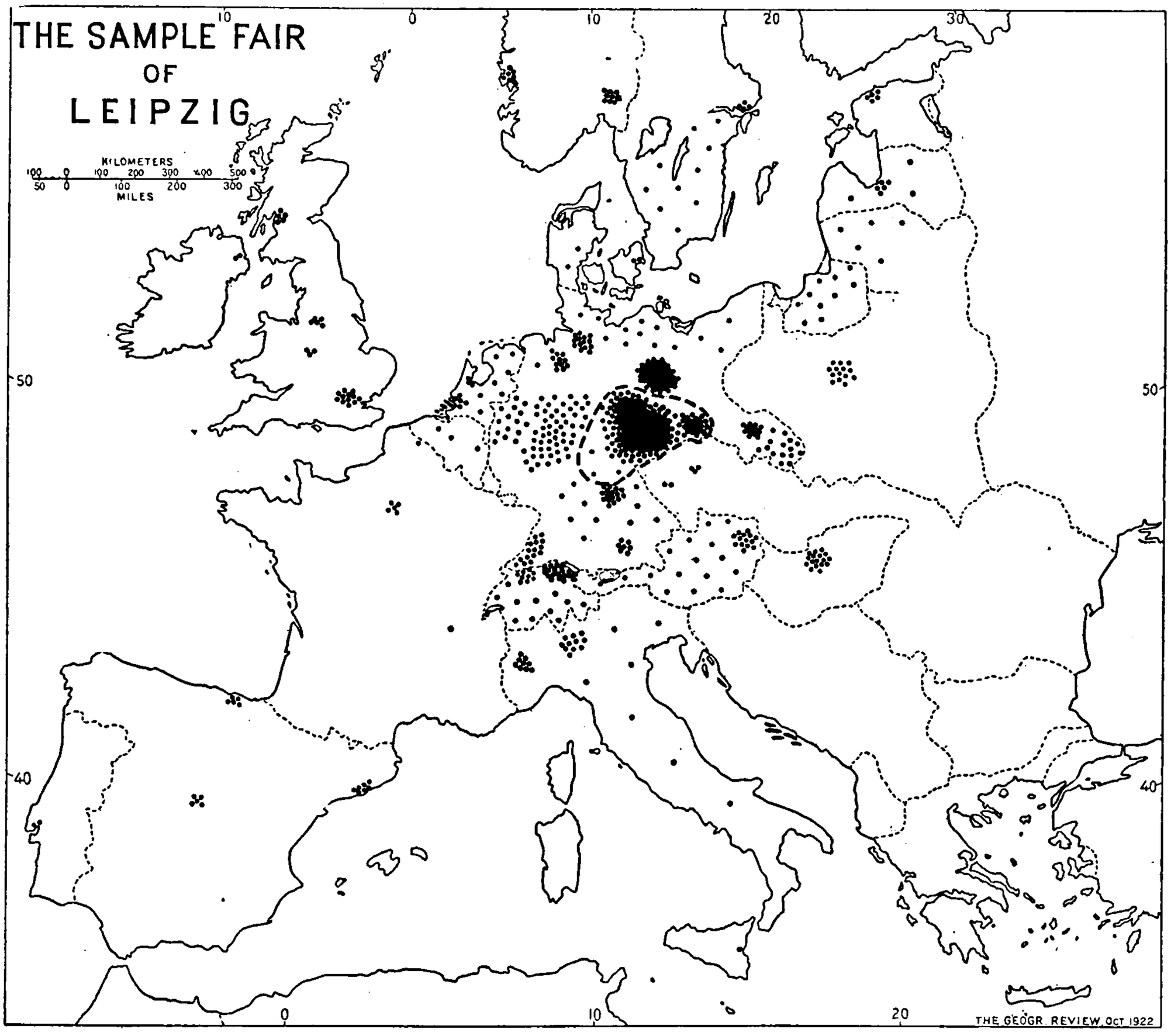


FIG. 12—The economic sphere of the sample fair of Leipzig. The heavy broken line shows the economic domain of the sample fair in its earlier years (1897–1917). Dots represent the point of origin of participants in the fair, each dot representing an average of 5 participants (1914–1922).

wooden products of Thuringia and the Saxon mountains; the basketry, papier-maché, blown glass, and porcelain of Thuringia, etc. Such are the wares that for twenty years have been offered in sample form at the new fair of Leipzig. It must be emphasized that the fair has played its rôle for a limited and well-defined geographical domain (Fig. 12). We may compare it in this respect with the live-stock fairs. Here is a veritable *umland* especially concerned with export, which business the fair facilitates as the fairs of the western Alps facilitate the exportation of cattle. The prime character of the German fair of the Middle Ages is thus reversed; the sample fair of Leipzig is *Ausfuhrmesse*—a fair of exportation, but for a limited *umland*. It should be understood, however, that while this definition is true at present it is not

final and does not exclude the possibilities of development in other directions. Even now it seems that the exhibition of merchandise produced from other more distant regions is an aid to the provisioning of the *umland* with its requirements. And there are indications that a possible function of importation will complete the character of the fair, which will thus conform closely to the definition that we have offered—a sort of inland port[42] satisfying the import and export needs of its *umland*.

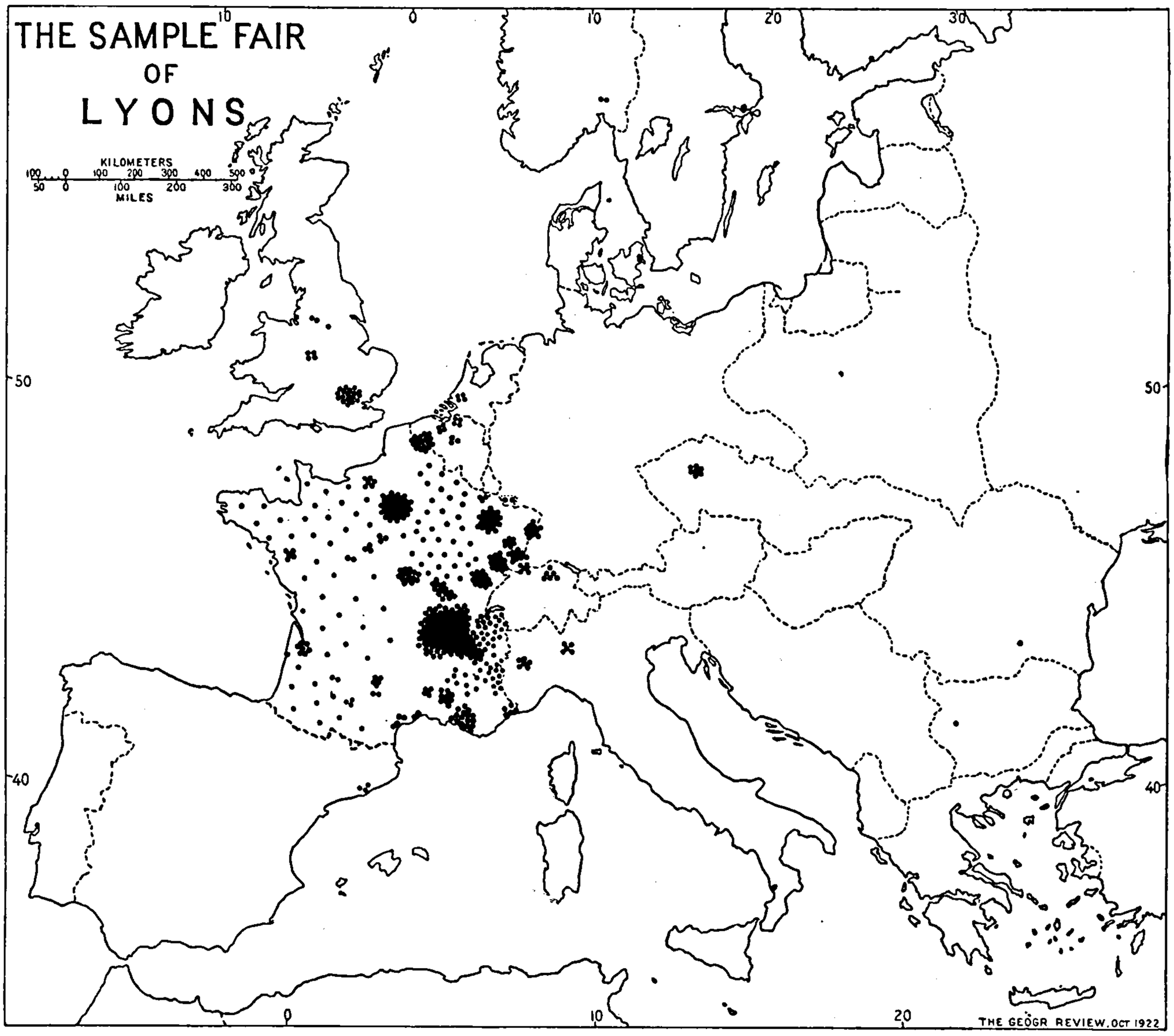


FIG. 13—The economic sphere of the sample fair of Lyons. Dots represent the point of origin of participants in the fair (spring and autumn), each dot representing an average of 5 participants.

However, the *umland* is not everything in the sample fair. It functions for a much broader terrain. From the beginning of the twentieth century, and especially since 1917 when the activities of the new fair of Lyons began to be manifested, that of Leipzig extended its influence to include the whole of Germany. Products from Westphalia appeared, and first the cheap cutlery of Solingen and the cheap jewelry of Pforzheim; then the products of the industries of Silesia and of Berlin, comprising altogether an infinite variety of manufactures in metal, wood, rubber, and chemical goods. For a long time foodstuffs, textiles, raw materials, and colonial products were not admitted to the fair, but they finally made their appearance during the war. In virtue of its character the fair is specially interested in placing new goods

[42] Arqué (*op. cit.*) expressly compared the fair to an "inland port."

on the market as speedily as possible. This is most peculiarly true of articles that vary according to the mode, and during the war was also the case with innumerable substitutes, *Ersätze*, chiefly in textiles and foodstuffs. Thus the fair became more complex, including all categories of goods and drawing producers and customers from all the territory of the Central Powers. At the beginning of the war and in view of the importance of the fair the *Verband* sought to have it recognized as an activity of the Empire with the participation of the German State, and this was realized at the end of the war. Nothing shows better the special importance of the fair of Leipzig—which in 1915 was attended by more than 20,000 exhibitors and buyers—and also the utility of this new vehicle in the complex commercial life of today.

Before leaving this analysis of the new fair of Leipzig we may recapitulate its basic characteristics. It is held at fixed times, towards Easter and at Michaelmas (end of September). It has a fair ground and special buildings in the center of the town, though the greater number of the exhibitors install themselves with their exhibits in rented chambers and apartments. Yet the fair is not part of the town. The *Verband* controls it, organizes publicity and propaganda, and enters into arrangements with transportation companies and hotels for the concession of special terms. Under a modern form these are the traits which we have seen in the old commodity fairs. One can even see the suggestion of a revival of the old "conduct of the fair" in the tickets, or certificates, issued to participants in the fair granting special advantages. During the war these tickets served, especially for foreigners, as veritable "safe-conducts." Again it may be compared with the *suks* in the localization on the ground of the various products exhibited; and foreigners, Swiss, Swedes, Dutch, etc., have their clubs and clubhouses which recall the old *fonduks*.

It is true that the chamber of commerce and the municipality play an important part in the administration of the fair, and it is evident that the town benefits from it and is interested in seeing it prosper. But we must again insist on the separation of the two things, the fair and the town. There is no absolute geographic bond between them. The fair lives for itself. Tradition, the skill of the directors, good organization, and especially the address that evolved the new form are the real reasons for the actual location of the fair. At the time of the fair the activity of the town is intensified, concerts and entertainments naturally gain with the increased population and are then most brilliant. Streets are decorated, processions parade the town, bands at their head; but, let us note, under this appearance of festivity it is always the interests of the fair and the fair alone that are considered. All these parades and merrymakings have but one object—publicity for such and such products offered at the fair. Trade in the town benefits by the influx of sightseers; but the administration of the fair is properly concerned with limiting their numbers; its interest here is just precisely contrary to that of the town. Only accredited business men are permitted to visit the

fair, and to do so they must show a badge for which they pay 20 marks—one of the sources of revenue of the fair.

## The New Fair of Lyons

The second great sample fair of Europe which is considerably younger than that of Leipzig was directly inspired by it. The Lyons fair had its inception in a suggestion made in 1915 and promptly taken up and put into effect by M. Édouard Herriot, mayor of the city.[43] The first sample fair of Lyons was held March 1, 1916, with the intention of making it an annual

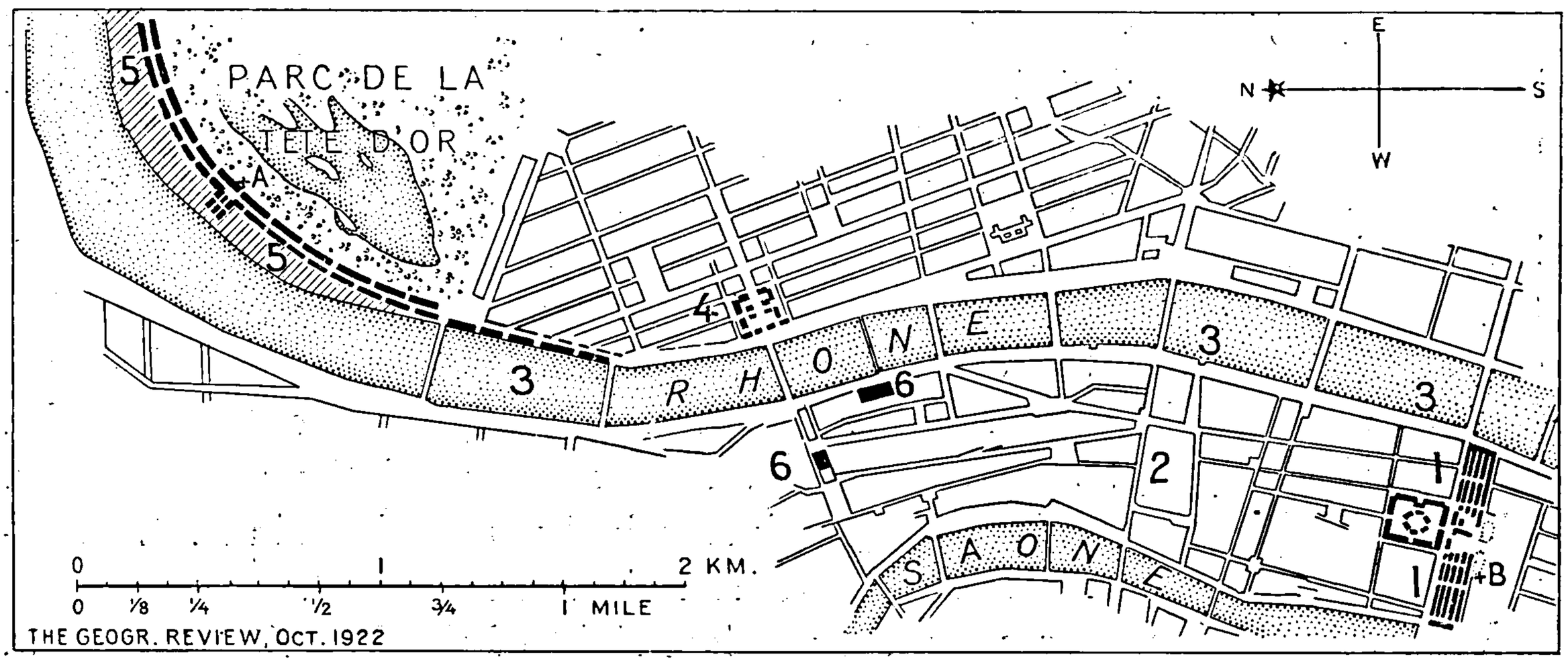


FIG. 14—Lyons, a part of the town and the sample fair. Numbers have reference as follows: 1 and 4, temporary wooden structures erected on public squares; 2, square occupied by a part of the fair in 1919; 3, quays occupied by a part of the fair in 1916, 1917, and 1918; 5, future fair palace—solid black showing part constructed in 1921; shaded, the part to be constructed from 1921 to 1930; 6, the permanent offices and exhibition of the fair. *A* indicates the viewpoint of the photograph Figure 16; *B*, that of Figure 15.

event. Such was the rapidity of its development, however, that from the beginning of 1919 it was necessary to make it a biennial event, and it is now held March 15 and October 15. Its success is manifested in the figures of the financial transactions accomplished therein; 95,000,000 francs in 1916; 410,000,000 in 1917; 1,035,000,000 in 1919; 953,000,000 in 1920. All kinds of merchandise are accepted under sample form. It may be noted, however, that the category of exhibitors is confined to direct producers and exceptionally to importers and wholesale merchants, unlike the Leipzig fair, which admits all classes of middlemen. Thus is explained the difference in the figures of participants for a commercial importance sensibly the same.

In 1918[44] the classes of merchandise sold through the medium of the fair were, in order of value, out of a total of 750,000,000 francs: cotton goods

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[43] Édouard Herriot: Une offensive économique, la foire d'échantillons de Lyon, *Rev. des Deux Mondes*, Vol. 32, 1916, pp. 758–787; René Hoffherr: La politique d'une foire d'échantillons: La foire de Lyon, Lyons, 1922; C. Germain de Montauzan: La foire d'échantillons, Lyons and St. Étienne, 1918; *Bull. Mensuel de la Foire de Lyon* (before 1920), *Lyon*, (since 1920). Archives of the fair and personal information. Special acknowledgment must be made to M. Charles Touzot, general secretary of the Fair, author of many articles in the above-mentioned publications and unpublished material, and to his collaborator, M. René Hoffherr.

[44] Étienne Fougère: La foire de 1918, *Bull. de la Foire*, p. 12, Lyons, 1918.

80,000,000; automobiles and cycles, 70,000,000; agricultural implements, 56,000,000; machinery, 50,000,000. Then followed electrical apparatus, metallurgical goods, leather goods, industrial construction materials, hardware, chemical products, boots and shoes, stationery, food products, colonial products, paper, ready-made clothing, furniture, hosiery, heating apparatus, skins and furs, silks (only 10,000,000), watches and clocks, toys, building materials, pottery, woolen goods, and lastly corsets and haberdashery (5,000,000). Amongst the diversity one notes the relatively small showing made by the products of the industrial region of Lyons proper; silks in particular, although this product is peculiarly adapted to such a form of sale. The reason is simple enough; the silk merchants of the town do not take the trouble to exhibit at the fair when they can benefit by the arrival of buyers in the town. It is but another instance of the permanent and fundamental unlikeness of interests between town and fair.

At Lyons, however, this unlikeness of interests is reduced to a minimum because the committee for the direction of the fair is exclusively composed of townspeople and the initiative came from the municipality itself, as five centuries before was the case with our old commodity fairs of which we flatter ourselves this is a revival. The fair is the private enterprise of a joint-stock company, but it has the strong support of the municipality, which indeed appears to be taking an increasingly great share in it. The administration of the fair has its headquarters in the town hall.

With all this, however, we must not lose sight of the fact that town and fair are distinct. To the average tourist they will probably appear more distinct than at Leipzig. Lyons is much less crowded and disturbed by the fair than is the German center. Of course there is greater animation than usual; the streets are illuminated at night, hotels and places of entertainment are filled, and the shopkeepers of the town show special displays; but there are no parades nor particular festivities, and the daily routine of the town is not sensibly changed. The gathering is exclusively a business affair and only frequented by business men. For this reason a good part of the fair, unlike that of Leipzig, does not occupy town buildings but has its own installations either temporary or permanent within or near the town. The only exceptions are two permanent services—the administration and a permanent exposition. The greater part of the fair is installed in temporary wooden structures erected twice a year on the public squares and the extensive quays along the banks of the Rhone. The number of these erections, however, is diminishing; and they will eventually be replaced by a stone building now in the course of erection on a great open space of common land outside the town. It is expected that this building will be completed in ten years and it is believed in Lyons that it will be the largest in the world. It will cover an area of 1,200 meters by 50 meters and will be four stories high. It is planned to include 64 separate pavilions connected by continuous galleries and comprising 1,360 exhibition stands, accommodations for the participants of the fair, rooms for meetings and conferences, restaurants, postal

FIG. 15

FIG. 16

FIG. 15—The sample fair of Lyons in 1921, temporary buildings on the public squares of the town. Compare Figure 14.

FIG. 16—A portion of the fair palace of Lyons, 2 of the 64 pavilions under construction. Compare Figure 14.

and telegraph offices; and it already has railroad connection and a station of its own. Thus buyers and sellers at the fair can sojourn there and transact their business *without once setting foot in the town*. The fair palace will be a complete town in itself, adjacent to Lyons but living only twice a year for a fortnight each time. This typical independent organization of the fair shows the essential features of its kind, elsewhere only completely realized at Nijni Novgorod. But Leipzig also is constructing permanent fair buildings and dreams of the erection of a great edifice, a skyscraper thirty stories high with 3,000 stands and 22 elevators. Nothing demonstrates better the fundamental distinction between fair and town that we have pointed out as characteristic from the earliest beginnings of the institution.

We cannot leave the fair of Lyons without briefly remarking on its sphere of economic influence. If silk makes a poor showing, other industries of the town are well represented—automobiles, chemical goods, shoes, and certain food stuffs. But the greater number of the products pertain to the surrounding industrial region and to southeastern France in general—the agricultural implements of the Saône valley, the electrical industries of the Alps, the machinery and tools of lower Dauphiné, of the northern Jura and Belfort and the Central Massif, especially St. Étienne and its neighborhood. The *umland* of the fair is clearly defined (Fig. 13), and it is a buyer as well as a seller; it gives the fair its complete rôle of an organ adapted to import as well as local export. The sphere of the fair, however, tends to stretch beyond this limited area to embrace the whole of France and even to pass the French frontiers. Only in the measure that one goes farther away from the town are other influences felt, and it is not the only sample fair frequented. Competitors are encountered in foreign countries, and even in France its domain is limited by the newer and more specialized fairs of Paris and Bordeaux. Yet it embraces a number of exterior relations that recall the activities of the great commodity fairs of ancient days. In November, 1921, it had agencies, private consulates as it were, in Brussels, Geneva, Prague, Milan, Rotterdam, Sarrebrück, London, Stockholm, Christiania, Seville, Constantinople, New York, Buenos Aires, Rio de Janeiro, and Peking. Its directors see in it not only a means of encouraging the French export trade and a system of intellectual propaganda,[45] but a place of contact and collaboration between traders from the four corners of the world. They seek to establish twice a year at Lyons a center for commercial information, for international credit, and especially an international clearing house for goods or money. And so by a circuit across the centuries we return to one of the most striking traits of the old commodity fairs.[46]

As yet, however, the rôle of the Lyons fair is predominantly national.

[45] This function recalls that of the ancient fairs of Lyons in the sixteenth century. They were the great center of the French book trade, as later those of Leipzig were for Germany. The printers of the town arranged publication for the time of the fairs. Caravans from the Mediterranean countries, especially Spain, after having sold their merchandise took books as return cargo. It has been repeatedly shown that the great fairs were an excellent means of diffusion of knowledge. See Alengry, *op. cit.*

[46] An instance of this international collaboration at the fairs is the fact that at the spring fair of 1921 the International Labor Bureau had a stand at Lyons.

Above all, during the war it rendered great service by making known French products, replacing those erstwhile obtained from Germany, an inverse form of the *Ersätze* of the Leipzig fair. It also served in equalizing the inequalities of supply and demand during the abnormal war and postwar periods.

## Other Examples of the Sample Fair[47]

The advantages offered by the sample fair have proved such that during the last five years several have been created in imitation of those of Leipzig

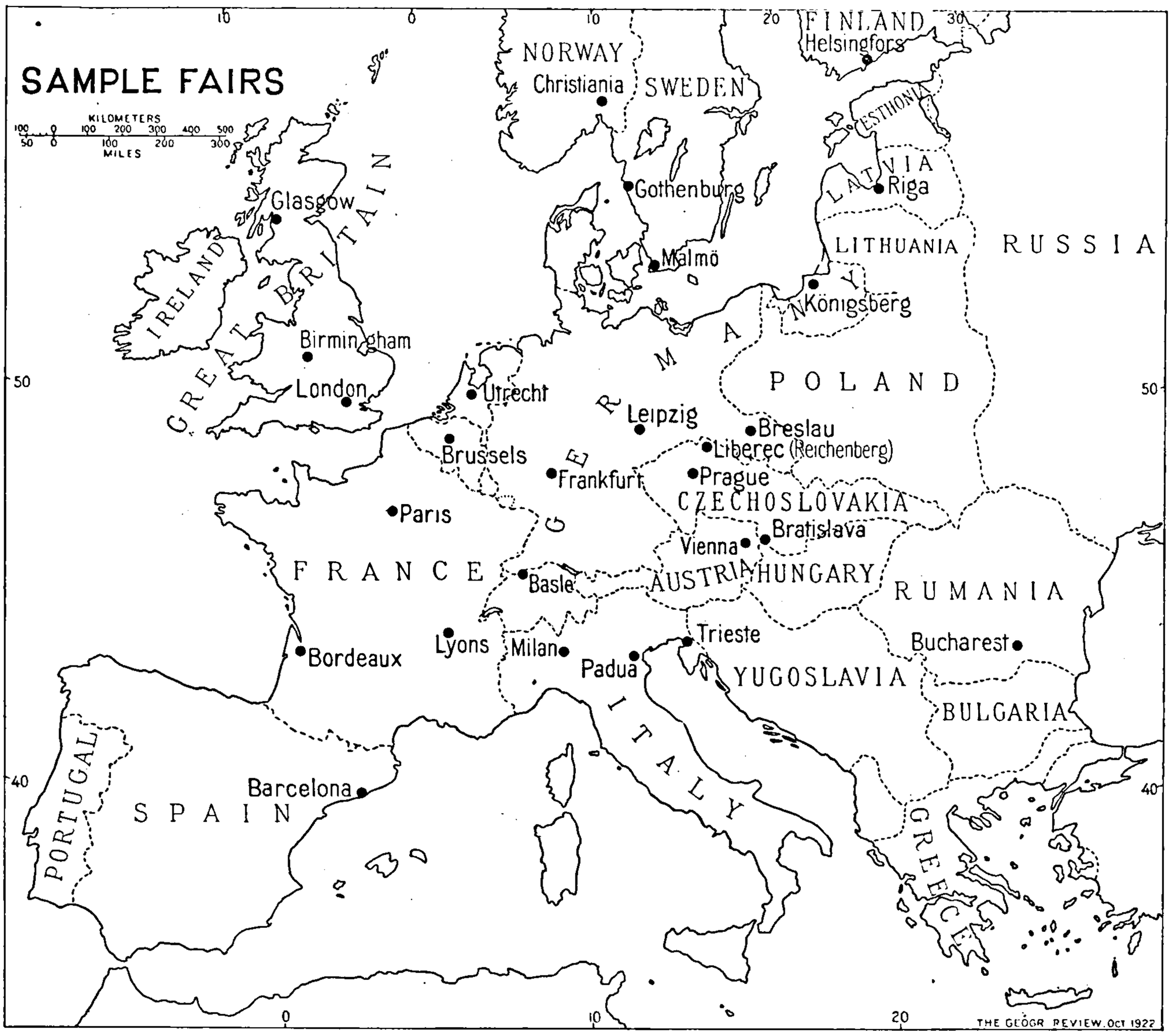


FIG. 17—Map showing distribution of the chief sample fairs of Europe in 1921.

and Lyons. Figure 14 shows the distribution of the principal sample fairs of Europe up to November, 1921. The oldest, after the two examples we have discussed above, is that of London, which dates from the spring of 1916. We shall say nothing of the geographic circumstances governing the location of these fairs, for this has already been developed apropos of the commodity fairs. It may be remarked that the majority of the new fairs have been organized like that of Lyons, with the specific intention of encouraging export from the home country. Each economic power has instituted one, sometimes several; in the latter event they may become competitive—a contingency that has been feared in the case of the three French fairs. They can, how-

[47] J. J. Martin: Les foires françaises et étrangères, in "Semaine du commerce extérieur," *Assn. Natl. d'Expansion Econ.*, Paris, 1921, pp. 208–221.

ever, act in collaboration; and this is the case with the three fairs of Great Britain which are held in such a way that the stranger can visit the three in a single trip.

As a consequence of each country having its own fair and seeking its own interests in competition with those of its neighbors, the respective *umlands* tend to coincide with the limits of the states; and hence they tend to be national in their normal function. They are international only for special reasons and now and then. The present tariff situation in Europe tends to frustrate growth of the international character that distinguished the ancient fairs. But if there is any institution that can ultimately transcend this barrier and reanimate international trade it would seem to be the fair with the various customs, fiscal, and transit privileges that lie within its power to secure.[48] We recognize in the sample fairs, as in the commodity fairs, the initial needs of frontier trade which, with the necessity for mobility, is the actual creator of the institution.

## Other Kinds of Fairs

There also exist other phenomena of commercial geography which are more or less related to the sample fairs and which are sometimes known as "fairs." Such are exhibitions known as "world fairs"—a term that came into universal use from the World's Columbian Exposition of Chicago in 1893. The idea of the world fair dates back to that inaugurated by the Society of Arts in London in 1851 and held under the presidency of the Prince Consort. It was quickly followed by like international exhibitions at New York and Dublin in 1853, Melbourne and Munich in 1854, Paris in 1855, and subsequently by many other well-known examples.[49] These, however, do not pass beyond what may be described as the advertisement stage and cannot properly be considered fairs, for they carry no mechanism for sale nor financial organization. The participants, for instance, charge their expenses to the publicity budget, while the participants of the fairs charge it against their sales accounts.[50] Exhibitions have only the superficial appearance of the real fair, from which even in that respect they are vastly different in the number of side shows and attractions for sightseers, sedulously avoided in the business fairs. On the other hand, the initial idea of the sample fair is approached in the fair of Kiev, discussed above under commodity fairs, which for half a century has made sales on order.

Other commercial events that approach more closely the sample fairs and which might even be included in that category are the annual motor and

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[48] In illustration we may quote from a note in *U. S. Commerce Reports*, August 22, 1916, on "Lyon's Second Sample Fair:" "The French Government on May 11, 1916, issued a decree prohibiting the importation of certain goods, and this prohibition is so extensive that it threatens to materially affect the importations from the United States. However, the mayor of Lyon, who is also a senator [deputy since 1919], has advised me of his success in obtaining a modification of this decree in so far as it applies to orders taken at the fair."

[49] See the article "Exhibition" in the Encyclopaedia Britannica, in which is also traced the history of the earlier national exhibitions.

[50] Ch. Tougot in *Lyon*, October, 1920.

cycle shows for the last twenty years held annually in London and Paris (since 1920 Paris has added an aeronautic show); they have been established expressly from the sales point of view and exclusively by sample. They may be considered rudimentary or, rather, specialized fairs as so many merchandise fairs became in their decline. They seem to indicate that under certain conditions specialization is necessarily forced on the sample fair and suggest that that may be a line of evolution followed in the future.

Finally, there is a new form of the sample fair to which indeed the strict constructionist would refuse the name of fair [51] but which is permissible according to our definition and is so described by the commercial world. These are either intermittent or itinerant fairs.[52] As we have seen above, there exist non-periodic commodity fairs. Similarly fairs have been recently organized under the form of expositions of samples with a sales organization attached but without intention of periodicity. Such were the fairs of Fez in 1916 and Rabat in 1917. These enterprises are most commonly organized in a foreign country with the object of soliciting a market. It was for this purpose that French business organizations arranged the "French fair of Stockholm" in 1920. Various countries, of which Great Britain was the first, have conceived the idea of sample fairs which travel to foreign countries and take up orders. Such a project in grandiose form is evidently only realizable by sea: in England it is one of the activities of the "Department of Overseas Trade" (Joint Department of the Foreign Office and the Board of Trade) established in 1917. The Netherlands, Italy, and Russia have circulated "floating fairs" on a small scale. France has given to the idea a more restrained form in her "sample trains," following a plan which had been devised in Russia in 1895 to compensate the inconveniences caused by the enormous distances in the Russian Empire. In 1920 a French train fair traveled through North America, notably in Canada. These ambulant fairs depart from the normal institution in that as yet they are purely national in character, officially designed as economic propaganda, that they have reference only to exportation, and above all in that they are not a place of rendezvous and of periodic contact between neighboring peoples. We shall, however, class them as fairs inasmuch as they possess to a supreme degree the basic geographical trait that they are itinerant commercial organisms.

## Conclusion

As the aim of the preceding discussion has been to portray the fundamental resemblance in the several kinds of fairs under the variety of forms they display, the discussion has inevitably assumed the character of a somewhat formal and abstract analysis: an intensely living and moving subject has perforce been reduced to dry categories. We should now like to see produced a number of monographs describing in detail this particular manifestation of

[51] See footnote 21.

[52] J. J. Martin, *op. cit.*

human activity in all its picturesque complexity; for among its multitudinous aspects it would be quite possible to disengage those of enduring value and geographical bearing.

## Definition of the Fair

It remains for us to give a geographic definition of the institution of the "fair." A tentative definition was advanced by the writer in 1914,[53] but a recent discussion has put in question his formula.[54] The definition of 1914 read "*a parasitic town, existing intermittently, periodically superposed upon a permanent town*, for the needs of the import and export trade of an *umland*." M. Roletto rejects as uncalled-for the neologism *umland;* but, as we have shown above, it possesses a more precise connotation than "economic domain." On the other hand, study of the fair, especially the merchandise fair, shows that its function often exceeds the needs of its *umland*[55] and hence that this word is not indispensable to the definition. We shall then modify it by substituting for the last phrase "*for the needs of itinerant commerce of a region in its entirety*."

M. Roletto denies the fair the right to the title of "town," because, he says, of its lack of habitations. But fairs with habitations are in fact more numerous than others; and the two cases of Goncelin and Pinerolo, analyzed above, are rather exceptional. Every one is familiar with the hawker's "caravan;" we have made reference to the accommodations provided in the fair buildings of Nijni Novgorod and Lyons and by the *fonduks* of medieval times and of the Islamic countries at the present day; and even when the fair invades the town, as at Leipzig, it loans dwellings for its own proper, if temporary, use. We maintain, then, our conception of the fair as a town, but an intermittent town, sometimes even, in part or whole, a nomad town. In a recent novel the term "wandering city" (*l'errante cité*)[56] was aptly applied in description of a pleasure fair: it is the moving city, or the city of itinerants. M. Roletto also rejects the idea of parasitism and substitutes that of coexistence. But parasitism here carries no derogatory sense but is the translation, rational and geographic, of the idea of coexistence. The fair temporarily invades a town and occupies it for purposes alien to the life of the town while benefiting from its geographical position and site and, obviously, from its facilities for support. Surely it has the significance of the ordinary technical meaning, where the uninvited organism makes its home with its host, but with the difference that the fair is frequently chosen by its host. M. Roletto has good reason to speak apropos of the fair of the *agglomeramento ospite;* it seems to us that he there gives expression to a new and useful idea—"host town," as we should render it in English, *ville-hôtesse* in French, and *Wirthstadt* in German. It is, with the *umland*, one of

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[53] *Op. cit.*, p. 333.

[54] Roletto, *op. cit.*, pp. 133–134.

[55] *Ibid.* M. Roletto shows it perfectly for the live-stock fair of Pinerolo.

[56] Jacques Chardonne: L'Épithalame, Paris, 1921, Vol. 1, p. 3.

the fundamental elements in the definition of every fair. Finally, in a formula inspired by the preceding but expressly limited by him to the particular case of Pinerolo, M. Roletto declares that the intermittent institution of the fair has been "created to satisfy the local and extra-local needs of a commerce specifically determined by the geographic conditions of the *host town*."[57] Our analysis, however, has shown that in general the rôle of the host town is much more limited; normally it is even more limited than that of the *umland*, since in the same region the sites of fairs can be changed while the business of the fairs remains unchanged. Therefore we maintain our definition as given above.

Rather is it the geographic conditions of the region that play the important part. Needs of commerce in primitive countries, exigencies of caravan transport, age-old wanderings of the herds in pastoral lands, present-day circulation of merchants in search of customers—all these movements expressive of human activity are in the fair temporarily but conveniently enough brought together. Shorn of the accessory facts that make its picturesque diversity, the fair is the expression of the needs of men constrained by nomad life to meeting and trafficking at intervals. It plays the same rôle in itinerant life as the town plays in sedentary life.

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[57] . . . "creato per soddisfare alle esigenze locali ed extralocali di un commercio Voluto specialmente dalle condizioni geografiche dell' agglomeramento ospite" (p. 134).

# SOME UNUSUAL EROSION FEATURES IN THE LOESS OF CHINA

By Myron L. Fuller

The general characteristics of the landscape of the yellow earth region of northern China are well known. The deep sunk valleys and deep worn roads, the vertical walls with their excavated dwellings, the natural terraces perforce figure in any description of "loess land." It is here proposed to discuss some of the minor forms exhibited by the loess.

## Natural Loess Bridges

Of the several striking forms resulting from loess erosion none is more conspicuous than the natural bridge. In general aspect (Fig. 1) the natural bridge of the loess closely resembles the familiar limestone bridge. The span of the arches seldom exceeds half the height of the opening: broad spans, such as those of the sandstone arches of Utah, are naturally unknown in a material which is unconsolidated, uncemented, and of limited cohesion.

Loess bridges are natural in their mode of formation, although certain artificial conditions, such as artificial terracing, may favor their development. They are invariably found near some abrupt change of slope, as along the rim of a ravine or canyon-cut plateau, near the edge of a flood plain, or on the interrupted slopes of terraced hillsides. A few have also been developed in the divides between headward-advancing ravines, whose upper ends are approaching each other.

The loess bridges, because of the limited cohesion of their material, are necessarily short-lived as compared with limestone and sandstone bridges; but weathering and erosion features associated with them seem to point to ages measured by hundreds of years, if not occasionally a thousand. They never span flowing streams but are limited to gullies in which water flows only after fairly heavy showers.

## Loess Bridges on Plateau Rims

Loess bridges occur most commonly on plateau rims. They are found where the waters of the flat or gently sloping upland surfaces find downward passage along the vertical joint, cleavage, or other structural planes of the loess, to relatively porous bedding planes, thence laterally to adjoining ravines. The passages, through combined spalling, caving, solution, and mechanical dissolution of the walls, become rapidly enlarged into vertical pipes or wells connecting with, or merging into, horizontal or

downward sloping tubes. Figure 2 is a view taken from the inside of such a tube, in this instance some three feet in width and ten feet in height, looking outward toward the valley into which it drains.

The next step in the process is the formation of other pipes and tubes along the line of drainage in the rear of the first (these later caving to form an open gully) or the eating back of the loess by the normal process of gullying. In the meantime the covering above the tubes is reduced, while

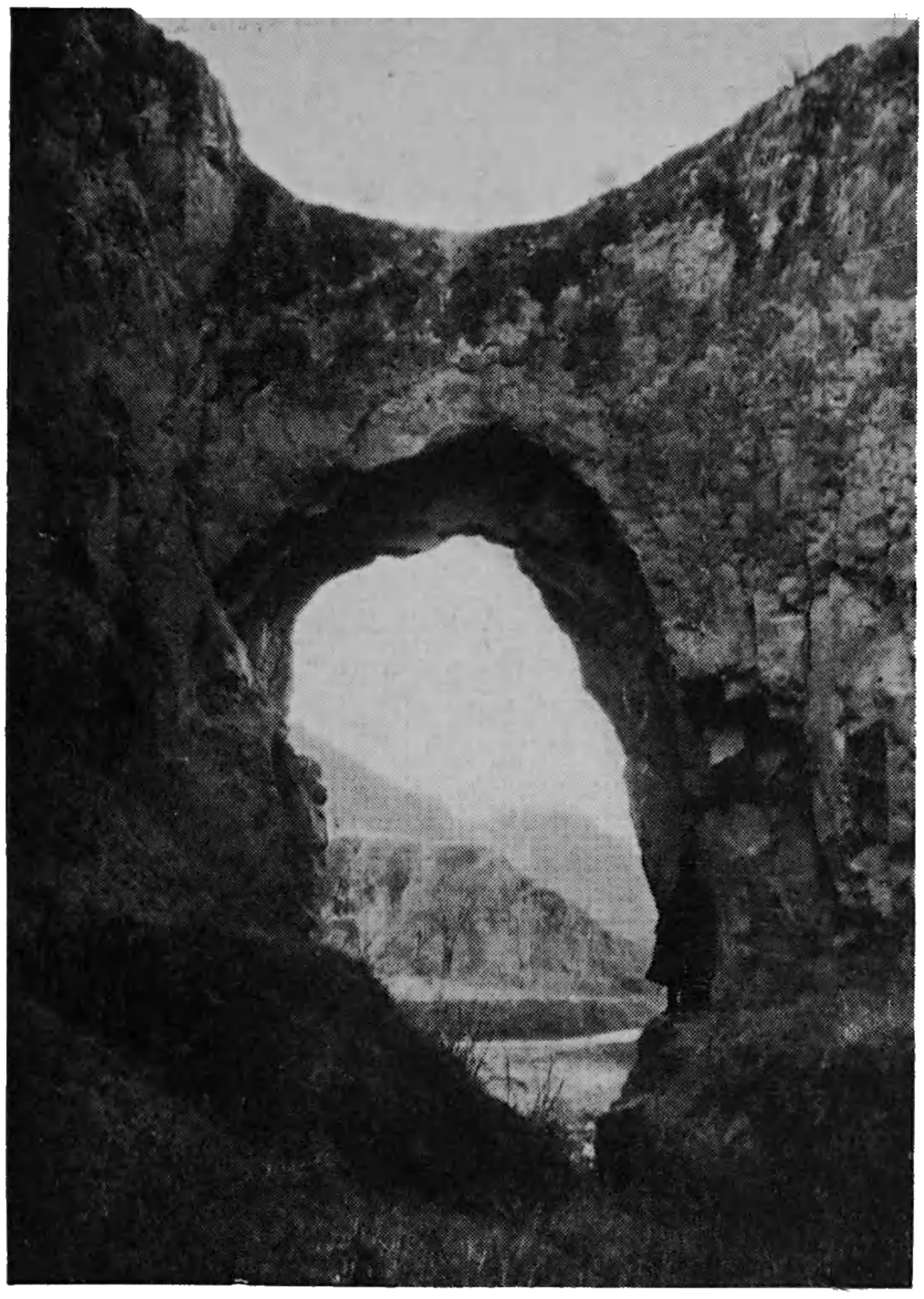

FIG. 1—Loess bridge spanning the mouth of a ravine.

FIG. 2—Looking outward from a loess tube connecting loess well or sink with valley.

the tubes are enlarged until, in the end, natural bridges alone remain spanning the gullies, which may lead backward into the uplands as open cuts half a mile to a mile or more above the arch. Figure 1 shows a good example of this type of bridge. A smooth, grassy remnant of the plateau constitutes the top. On the sides, at the level at which the man is standing, are shelves marking a former position of the floor beneath the arch, now cut to a depth of five to eight feet by a sharp V-shaped notch, as a result of the rejuvenation of erosion. The breadth of the arch is about 15 feet and its height about 35 feet above the bottom of the notch. The opposite hills rise to heights of 300 to 500 feet and are entirely of loess. The characteristic jointing, which so facilitates the penetration of water, is seen on the right.

## LOESS BRIDGES ON TERRACED SLOPES

The artificial terracing of valley sides as an aid to cultivation presents conditions particularly favorable to the formation of loess bridges. The

normal run-off is checked both by the flat steps and by the raised rims which enclose the terraces on the outer sides, with the result that the water has a more than ordinary tendency to follow the perpendicular plains downward into the loess and thus to the formation of vertical pipes and connecting tubes and, eventually, the development of natural bridges as out-

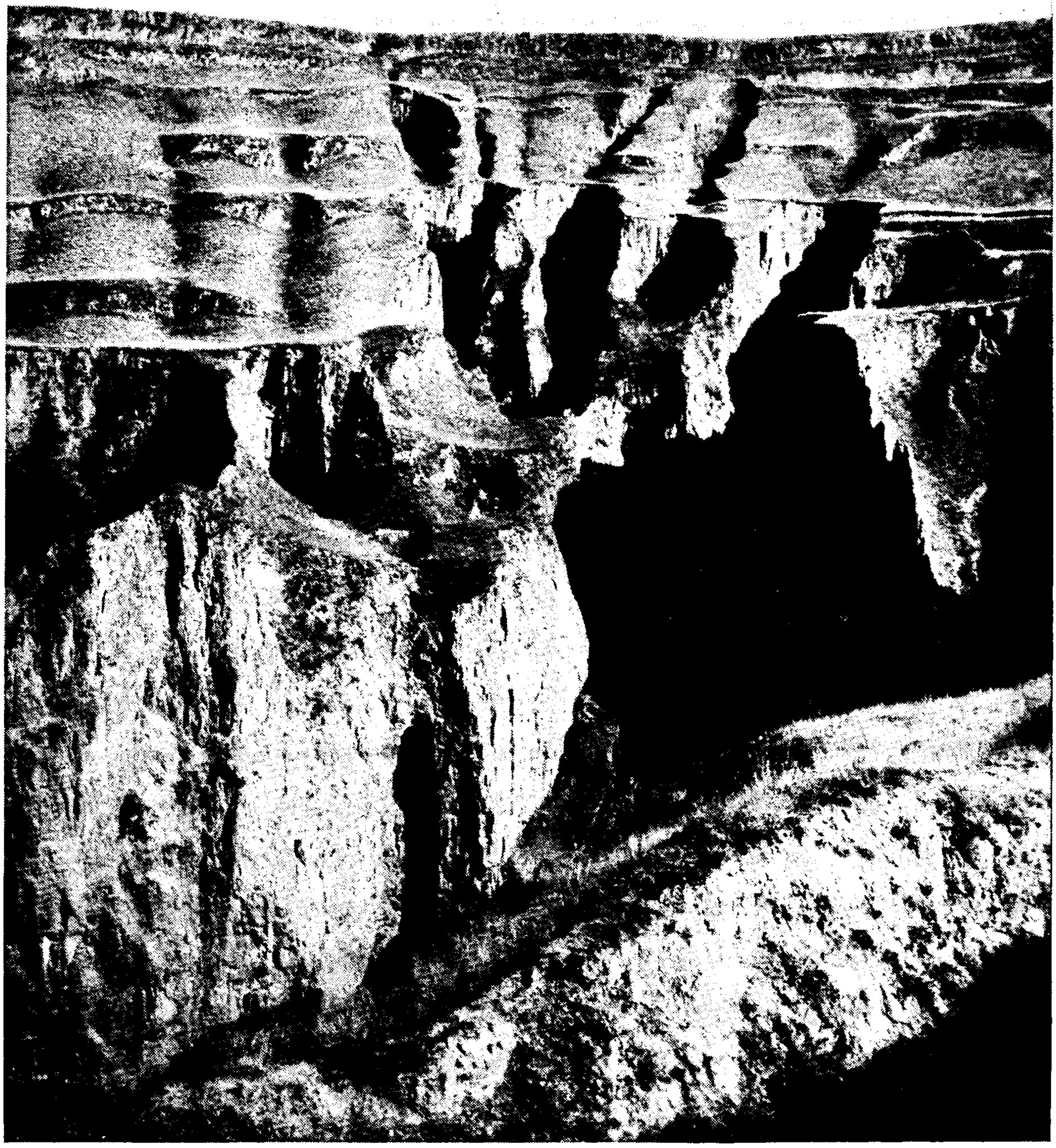

FIG. 3—Loess pipes, tubes, wells, and sinks on terraced slope.

lined above. Figure 3 shows the earlier stages of bridge formation on a terraced slope. In the foreground is the mouth of a tube, similar to that of Figure 2, draining the two small pipes immediately above as well as the larger loess well in the rear. In the center, to the right and somewhat above the foregoing, is an older, much enlarged, irregular well draining outward under a bridge into the ravine within the dark shadow on the right. Above this big well or sink, in turn, entering it beneath bridges in shadow, are three open gullies leading back to the edge of the plateau. As in the case

of the plateau bridges, the water movements concerned take place far above the normal ground-water level. Details of the subterranean erosion of the loess are more fully discussed in the section on loess wells.

## Loess Bridges Along Streams

The bridges along streams are not formed above the water table, as were the bridges previously described, but are the result of normal ground-water movements, through which parts of the loess are mechanically removed and borne to the stream toward which the waters drain. The result of this undermining is a series of jagged gash-like sinks, often paralleling the river for some distance, as shown in Figure 4. In the walls between the gashes and the streams a number of loess windows and bridges are usually found; but they are short-lived, the walls soon crumbling by the mechanical erosion of the supporting loess. No instance of the formation of a bridge by normal undercutting was observed.

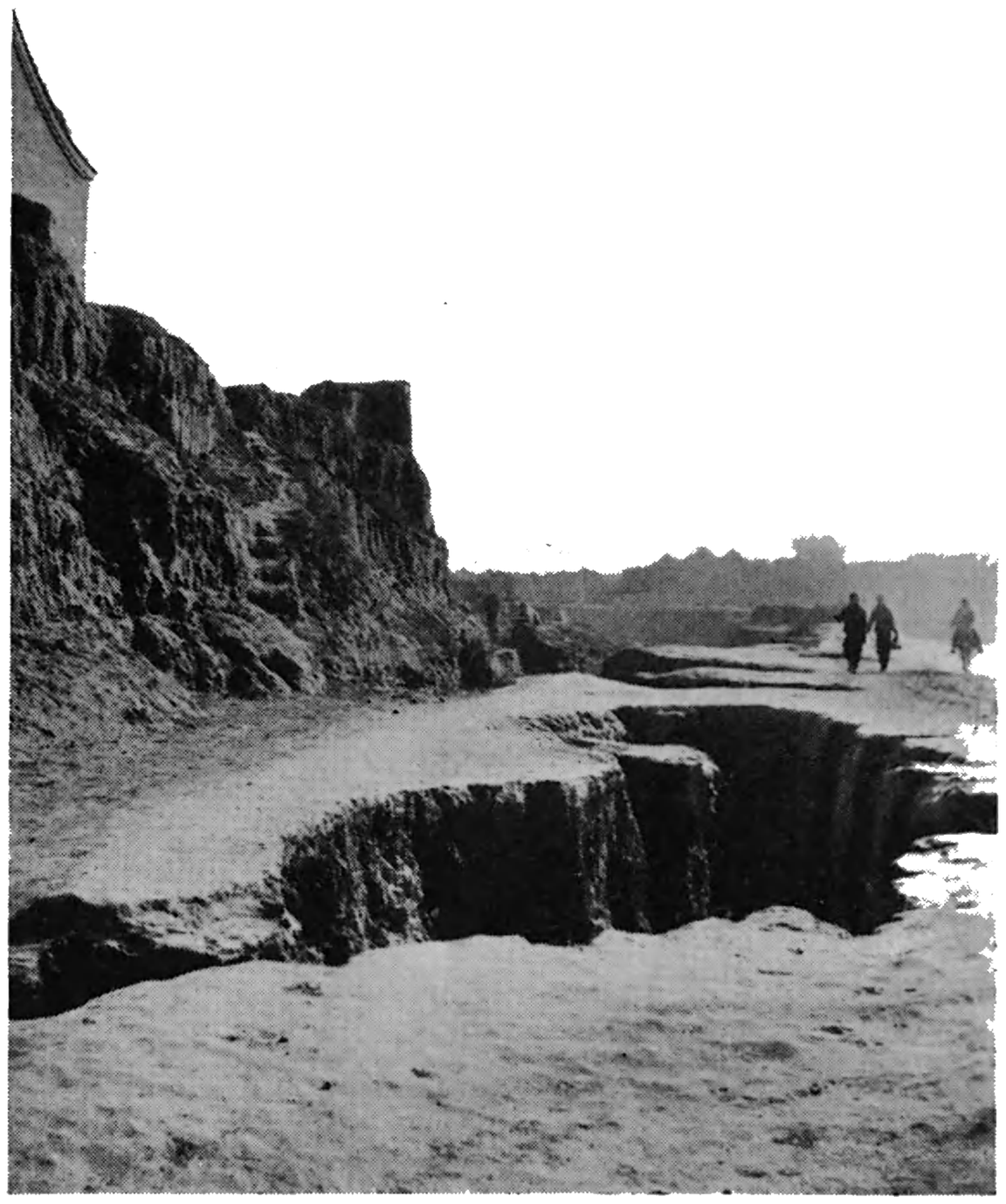

FIG. 4—Loess gash sinks paralleling a stream.

## Bridges of Flood Plains and Divides

In the loess regions of China the flood plains of the streams are mainly composed of eroded, transported, and redeposited loess, which, in the absence of sand, gravel, or organic material (the latter rare under the existing arid conditions) is indistinguishable from wind-deposited loess. The wet-weather drainage across such flood plains has occasionally produced bridges of six to ten feet in span and ten to fifteen feet in height, under conditions essentially similar to those described above.

When two complexly branching and opposing stream systems cut backward in the thick loess, it is inevitable that individual gullies will occasionally head against one another. In many cases where the erosion has been rapid, the gullies terminate in vertical walls. Under such conditions the bottoms may be cut through while the tops are still preserved, leaving natural bridges of varying span and height.

## Distribution of Loess Bridges

Loess bridges are characteristic of youthful stages of erosion and are limited, so far as the writer's observations go, to those regions where there

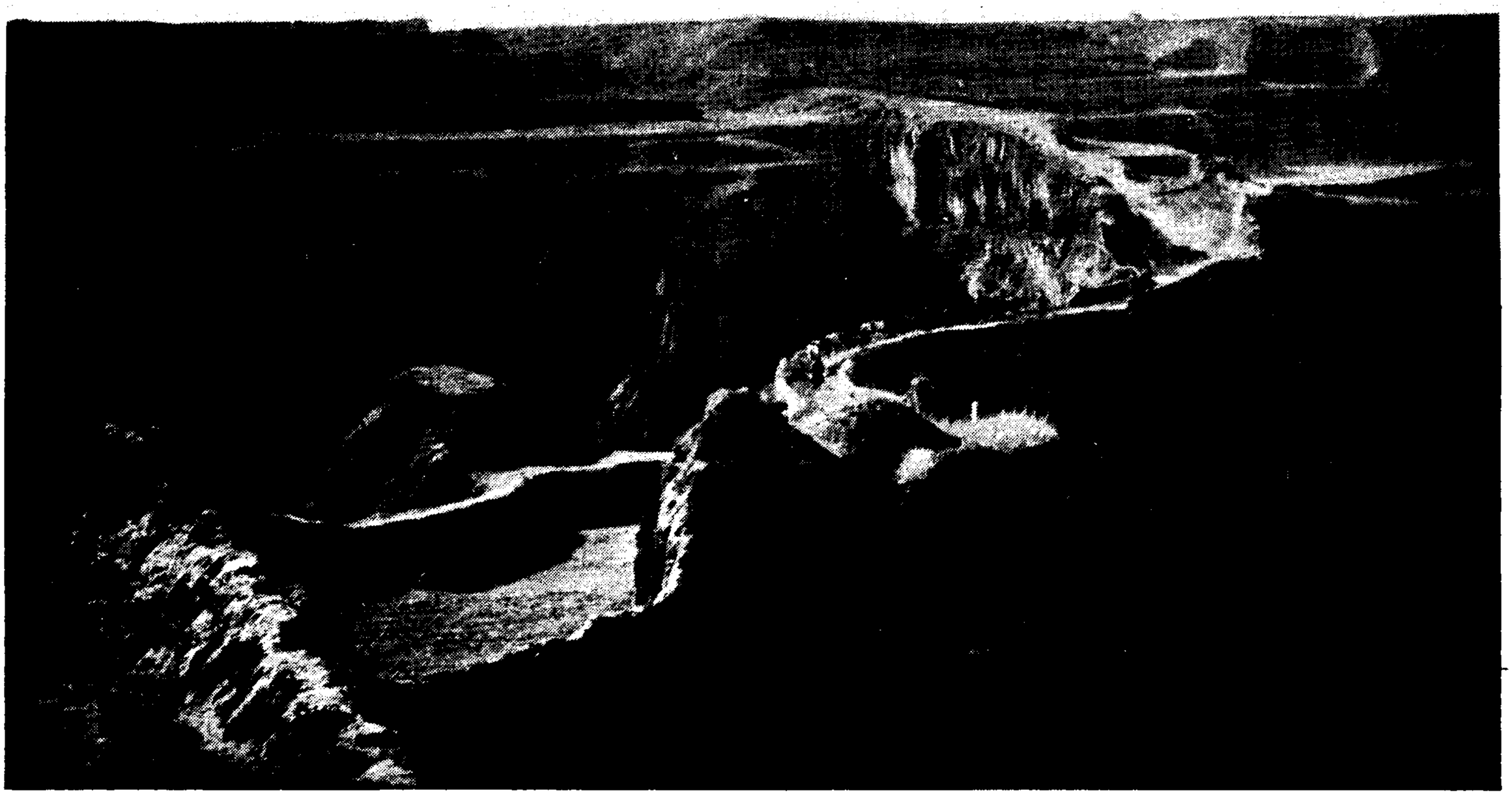

FIG. 5

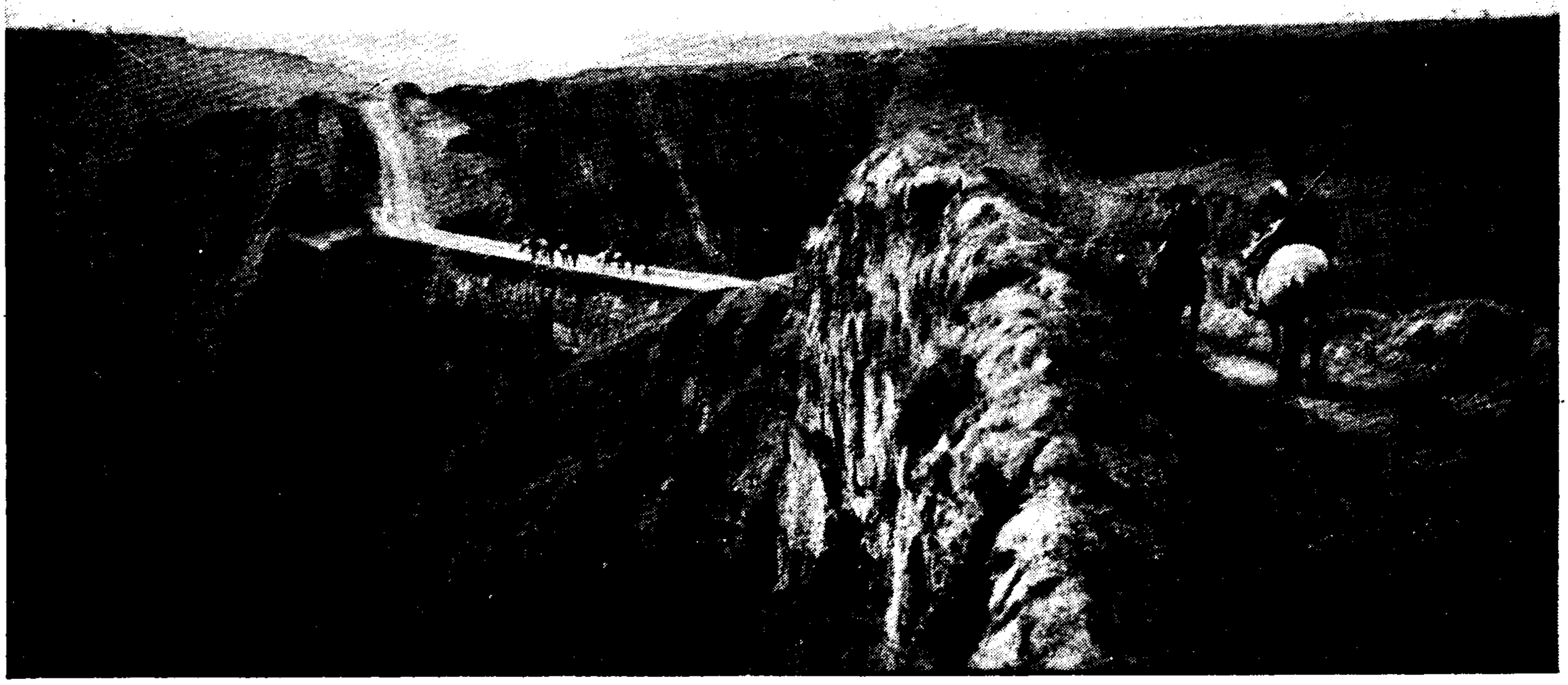

FIG. 6

FIGS. 5 and 6—Loess dikes between the heads of opposing streams. Both examples occur on important routes and show evidence of artificial maintenance.

has been increased erosion following recent rejuvenation. This rejuvenation may be due to the supposed recent deforesting of the loess area by man, to an increase in average rainfall, or to differential elevation of the loess area. The first cause is regarded by the writer as doubtful in most cases. The last, which is borne out by many features of the loess topography itself, as well as by certain features of the rock valleys of the Hwang Ho and tributary

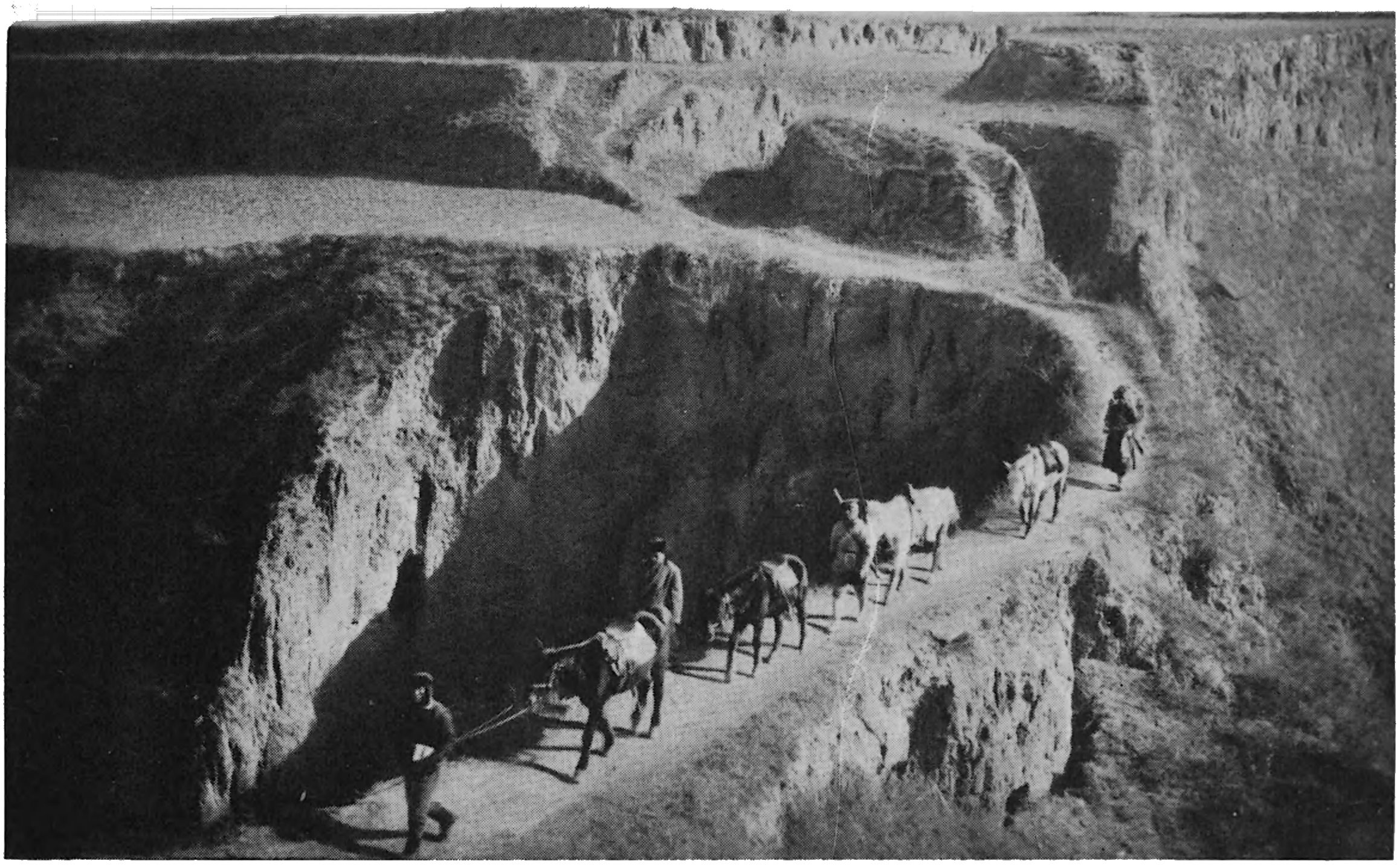

FIG. 7—Loess dike forming the divide between two streams eroding unequally—one (to the left) rapidly, the other (right) slowly.

streams, is regarded as the most probable cause of the accelerated erosion and the formation of the loess bridges. The examples illustrated are all on tributaries of the Hwang Ho in eastern Shensi.

## Loess Dikes or Wall Divides[1]

The traveler in the more deeply dissected portions of the loess is certain to retain vivid impressions of the dizzy heights of the narrow, vertical-sided dikes which constitute the wall-like divides between the heads of opposing ravines.

The dikes are usually fairly straight,[2] but a few are curved or even

[1] The name wall divide has been suggested by W. M. Davis and D. W. Johnson.

[2] Compare the illustration, Figure 4, of F. G. Clapp: The Hwang Ho, Yellow River, *Geogr. Rev.*, Vol. 12, 1922, p. 8. Several photographs have been loaned for use in this paper by F. G. Clapp.

sinuous (Fig. 5). Their faces, in the central portions at least, are nearly or quite vertical and from 50 to several hundred feet in height. Connecting the plateau levels on either side, they form natural passageways which have been utilized by the Chinese from time immemorial in their travel on foot or mule. They are seldom over ten feet in width, often no more than five feet, and the views of the depths below from the backs of horses or mules are found by many disturbing if not actually terrifying. Indeed, even the natives often dismount on the narrow dikes and sometimes actually crawl across on hands and knees. Nor is the danger entirely imaginary, for after protracted rainless seasons the loess becomes exceedingly dry and considerable masses not infrequently scale from the sides, sometimes precipitating mules and even men into the depths below. Some of the dikes traversed by the writer's associates in China had dwindled to a width of less than a foot and crumbled even as the mules passed. Since their use saves descents of many hundreds of feet into the precipitous ravines and heartbreaking climbs back to the plateau levels on the opposite sides, they are never abandoned as long as a mule can scramble across.

While the sides of the dikes are characteristically vertical, their attitude is really dependent upon the rapidity of backward erosion. Where the streams on either side of the divide are eating back slowly, the walls may not have angles of more than 45°. When one is eroding slowly and the other more rapidly, the walls may be respectively sloping and vertical, as on the right and left sides of Figure 7. With rapid erosion on both sides, each wall is vertical.

The lengths of the narrow portions vary from a few rods to several hundred feet, but the approaches are often over narrow spurs of much greater length (Fig. 5).

## Formation of the Dikes

The primary causes leading to the formation of loess dikes are definite and simple, being normal headwater stream erosion acting on a soft material with vertical jointing or at least a marked tendency toward vertical scaling.

Why the dikes are so long and so straight is not so clear. The straightness and smoothness of the sides often give an appearance of artificiality, but in only a few instances was any actual evidence of the hand of man recognized. The most conspicuous examples of artifically maintained dikes are shown in Figures 5 and 6, the first on an important trail near Chung Pu:[3] the second on the main cart road of north Shensi near Lo Chwan. The smooth sides of both give unmistakable evidences of human workmanship. Figure 7, on the other hand, shows a dike which appears to be untouched by man. In the case of one or two of the smaller dikes it was observed that brush had been placed to retard the wash.

[3] See the map "The Great Wall of China," *Geogr. Review*, Vol. 9, 1920, opposite p. 268.

It is evident in many instances that the opposing ravines, having cut back to within a few feet of one another, begin to broaden out on both sides, instead of cutting through the narrow separating walls. The high, narrow dikes may indeed remain while gullies are cut back laterally, perhaps for hundreds of feet. The prevailing straightness of the dikes suggests a relation between their form and the use to which they have been put by man. Possibly the compacting of the tops under the feet of travelers, who commonly outnumber the mules or donkeys, makes the surface more

FIG. 8—Erosion pinnacle in normal loess.

FIG. 9—Turret pinnacle in aqueous loess and gravel.

resistant to the penetration of rain and scaling, or the lateral ditching along lines later followed by side gullying may aid in determining the form of the dike. Both suggestions seem far-fetched, but the fact remains that the erosion actually takes place as described and leaves the long, straight, high divide walls or dikes.

## Loess Pinnacles

Loess pinnacles, standing as detached tower-like or needle-like masses, are not uncommon features of loess erosion in China. In origin the loess pinnacles may be either wholly natural or the result of a combination of natural and artificial conditions. They may take the shape of turrets, spires, sharp cones, thin, finlike masses, or of combinations of two or more of these forms. The material is usually pure loess but may be a mixture of sand and gravel with reworked (aqueous) loess.

### Turret Pinnacles

Flat-topped turrets of pure loess are rare, for the reason that the caps of such pinnacles, consisting of loess which has lost its normal cohesion through its conversion into soil and the penetration of rootlets, do not long preserve their vertical faces but rapidly scale away at the sides until their terminations become mere points. Such an example is illustrated in Figure 8, which shows a pinnacle about 40 feet in height and 13 feet in diameter. A pinnacle of this form may be regarded as transitional between turret and spire. The true turret form is shown by the gravel and loess pinnacle of Figure 9.

The turret pinnacle is practically always the result of normal natural processes of erosion. In the majority of instances, the loess masses first become detached as a result of the differential retreat toward one another of the vertical loess walls of the V-shaped points between valleys joining at acute angles. The severed bodies that result are triangular, rounded, or irregular in outline and may be of considerable size. They suffer slow reduction mainly by the spalling of slabs from their vertical faces. Sharply projecting points not infrequently become severed from irregular loess cliffs and by the same process are converted into turret pinnacles, or again they result from the reduction of masses detached by cut-offs of broadly swinging streams; but these last are not common.

### Spire and Needle Pinnacles

Spire and needle pinnacles have the general form shown in Figure 8, but they are more slender and needle-like, with diameters only a small fraction of their heights. In 8,000 miles of traverse only a few were seen, and these under conditions which did not permit them to be photographed. An idea of the form of such needles or spires may be gained by imagining the left portion of the pinnacle of Figure 8 to be split away along the line of separation already seen to be developing, leaving the slender right section standing alone. Such pinnacles are usually not over twenty or twenty-five feet in height and three to five in diameter. They are probably most frequently the result of the scaling of masses from cliffs. The beginning of the separation of such a spire is shown on the right side of the loess canyon of Figure 10. Since this separation is the result of movements of the detached portions themselves rather than the removal of material in their rear, there must be a certain crushing or movement of the material of their own bases which largely destroys the natural coherency of the loess. For this reason, the spires produced by this type of spalling are weak and short-lived.

### Conical Pinnacles

The conical pinnacle is a steep-sided, usually slightly blunted, cone of loess having a height from one to two times its diameter. An example is

shown in Figure 11 which has an approximate height of 50 feet and a diameter of 30 feet, a size above the average, for the majority of the forms that may properly be regarded as pinnacles do not exceed 30 feet in height or 20 feet in diameter. Conical pinnacles result from the same natural processes as in the case of the turret pinnacles and also in considerable number from partly artificial conditions. The soft loess of the roads and trails is churned up by the wheels of carts or the hoofs of mules until a bed of loose dust six inches to a foot or more deep is formed. This is either picked up by the wind and whirled away or washed out to some near-by valley by rain. Sometimes several inches is removed during a single storm.

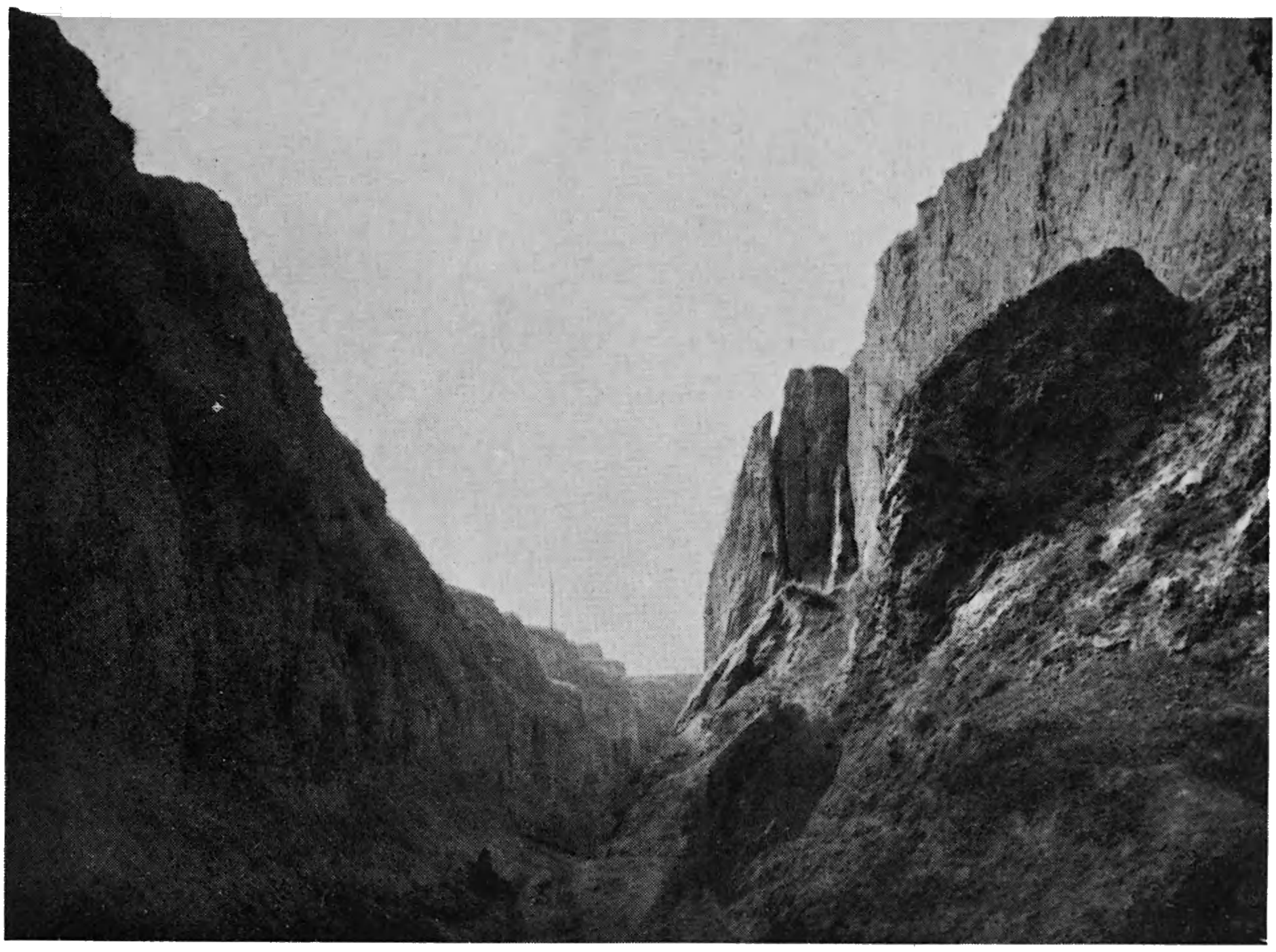

FIG. 10—Beginning of separation of spire pinnacle from loess cliff.

and the road or trail gradually becomes a miniature canyon. Many are now 50 feet in depth, and some 75 to 100 feet or more, though most are abandoned before reaching the latter depth. In a large number of instances new roads are started close to the rims of the old ones, and, as they in turn are worn down, parallel canyons, separated by thin loess walls, result. By the natural processes of scaling and spalling, the walls are slowly broken down and a series of cones, spires, or fin pinnacles remains to mark the points where they were thickest. The conical pinnacles thus formed, many of which mark roads abandoned hundreds or even a thousand years ago, far outnumber those formed by purely natural erosion. Figure 11 shows two residual pinnacles of this origin. In this instance, three lines of former road at two levels are involved, while as many others skirt the rims outside the limits of the picture, which shows one of the oldest roads of Central China, possibly dating back to 2000 B. C. There is reason to believe that

many of the loess-canyon systems, although now showing no trace of roads, had their inception in the wear and wash of ancient highways.

### Fin Pinnacles

The fin pinnacle is a tall, thin, elongated, flat-sided mass of loess with notched crest, suggesting in its general form the dorsal fin of a fish. The central mass of Figure 12 represents a pinnacle of this type. The height is 40 or 50 feet, and the thickness five or ten feet. Fin pinnacles are rarely the result of normal erosion. It is conceivable that under especially favorable conditions they may originate between two closely adjacent streams or at the necks of oxbows, but no examples of either were noted. The great majority of those seen represented broken-down partings between ancient double roads.

Another important class is that formed by a similar process along the rims of cliffs. In those parts of China where the intense struggle for a living compels the utilization of every possible inch of tillable land, the upland roads and trails are crowded, wherever possible, to the very edge of the cliffs bounding the plateau remnants. As such roadways become worn down, narrow loess walls remain between them and the cliff faces and in the process of gradual reduction give rise to numerous fin pinnacles.

### Distribution of Pinnacles

The pinnacles do not seem to be limited to any particular locality, providing the loess sheet is of sufficient thickness to permit their development, and they may be looked for anywhere in the great loess area lying between the Mongolian, or Gobi, Desert on the north and the mountains of southern Shensi on the south, and between the Coastal Plain on the east and undetermined limits in western Kansu or beyond. There seems to be a more marked tendency toward the formation of pinnacles in comparatively humid Shensi and Honan than in the more arid Kansu. Few were seen in Shansi, possibly because of the comparative thinness of the general loess sheet, partly because of less sharply developed erosion and the prevalence of more gentle slopes, and partly owing to the greater precautions taken against gullying on the part of the more numerous inhabitants.

## Loess Wells

A loess well is a circular hole of varying size and depth closely resembling in appearance an ordinary well dug for water before it has been stoned up (Fig. 13). The usual diameter of the wells seen was eight or ten feet, but occasional diameters as small as five feet or as great as 20 feet were noted. The wells were never less than 15 feet in depth and seldom more than 30 feet. The walls were vertical for practically the entire depth. Bottoms were cup-shaped or irregular and usually deeper on the far side with refer-

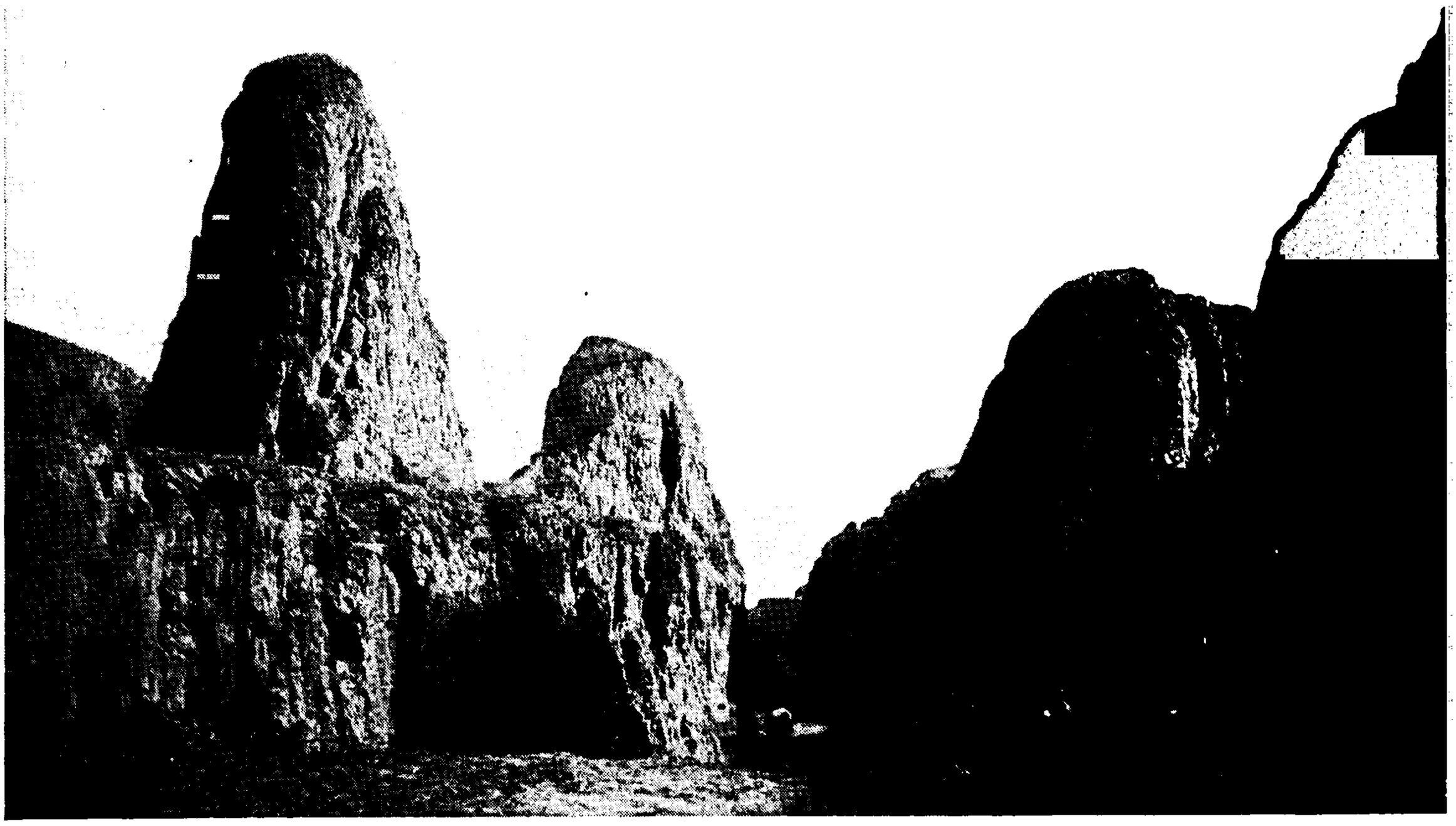

FIG. 11

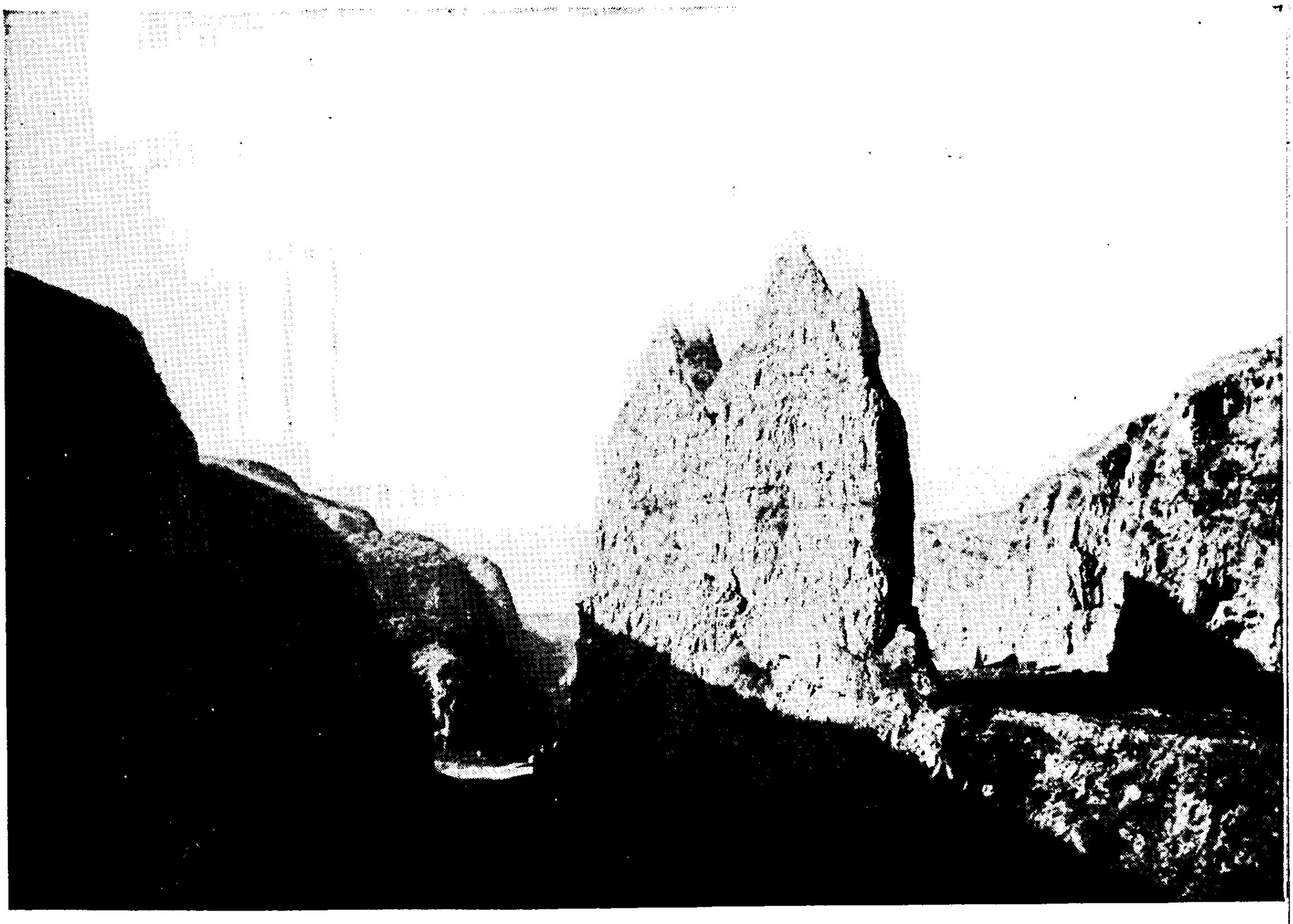

FIG. 12

FIGS. 11 and 12—Loess pinnacles left by the erosion of ancient parallel roads. Figure 11 shows a conical, Figure 12 a fin pinnacle.

ence to the direction of ground-water movement. In some instances openings a foot or two in diameter, occasionally larger, led away from the well in the same direction.

All the typical loess wells seen by the writer were in the eastern portion of the province of Kansu, about 600 miles southwest of Peking. None were encountered in Shansi or Shensi, although both provinces, which are deeply loess-covered, were crisscrossed from north to south and east to west by numerous traverses. Each of the latter provinces afforded, however, instances of irregular tubes and gashes apparently of the same origin as the circular wells, and it is to be supposed that wells also occur.

The loess wells always occur on flat upland surfaces of the general loess plateau not far removed from gullies, ravines, canyons, or deep valleys where walls are vertical or at least very steep. Probably few wells are found more than 150 feet from the plateau rim, while most are within 100 feet of it. They are not associated with surface depressions but are formed on flat surfaces like that shown in Figure 14.

The loess wells are clearly of the nature of sinks, but they result primarily from settling consequent upon the mechanical removal of underlying material rather than from its removal by chemical action as in ordinary limestone sinks. Their inception seems to result from seepage movements, sometimes along bedded layers, which, although differences are indistinguishable to the eye, are, nevertheless, more porous than the surrounding material; but more frequently they result from water movements along irregular channels leading diagonally downward through the loess toward an adjacent ravine or valley at angles of 30°, 45°, or even 60°. They are entirely above, and unconnected with, either normal or perched ground-water tables and represent simply the lines of least resistance to percolating waters.

The water movement along such lines probably results in some solution of the calcareous particles of the loess but leads first to increased porosity rather than to open passages. Soon, however, the openings along the line of movement become large enough to permit the mechanical transportation of the finer particles of the loess; and more or less tubular channels, analogous to those giving rise to the springs of clays and glacial tills, are formed. Eventually, by the caving of roof and walls, these may reach diameters of a foot or more. Wherever, along such passages, the well-known tendency of the loess to vertical cleavage happens to be most strongly developed, caving from the roof will begin on a more conspicuous scale. Downward percolation of waters from the surface furthers the process, and perpendicular cylindrical cavities will be extended upward, finally reaching the surface and giving typical loess wells.

In dry times the drainage passages tend to close by spalling or caving but they are reopened after heavy rains. By progressive enlargement the areas between the wells and the mouths of the outlet are undermined until, in the end, ravines heading at the wells replace the underground passages.

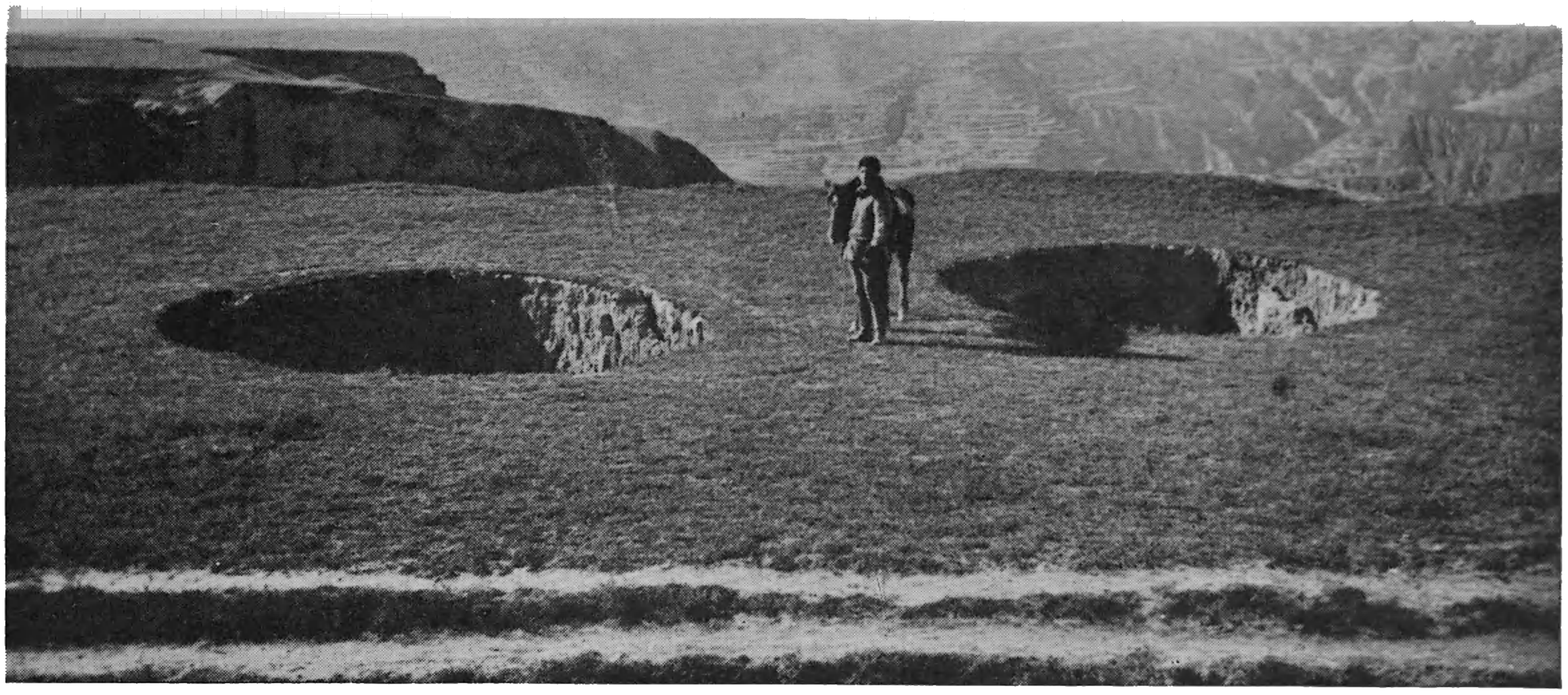

FIG. 13

FIG. 14

FIG. 13—Natural wells in loess on the plateau surface near a canyon rim.
FIG. 14—Typical loess plateau, near the rim of which the natural wells are developed.

In at least one instance a loess well has been known to result from the caving of an abandoned underground dwelling dug into the face of a cliff 30 feet or more below the surface in which the well was developed.

There is no definitely known cause of the limitation of the wells to the Kansu area. Possibly the reason lies in the more calcareous nature of the Kansu loess, which is nearer its source, Mongolia, and has been largely a direct deposit of the wind, while to the south and east water transportation intervened before the final distribution of the loess by winds. The greater rainfall in Shansi and Shensi may also favor the formation of large gashes and irregular cavities rather than the smaller and more symmetrical wells, while the latter, if formed, might be sooner destroyed by the more copious rainfall.

# THE UNGUARDED BOUNDARY *

By JOHN W. DAVIS

Of the many artificial lines which the hand of man has traced on the habitable surface of the globe, certainly at the moment none exceeds in significant importance the one to which I beg to direct the attention of this distinguished audience. Bismarck is reported to have said that the most significant circumstance in current history was the fact that practically the whole of the North American continent speaks the English language. The meaning which he attached to that fact finds its symbolic expression in the location and history of the boundary line between the United States and Canada.

On a front of 5,400 miles, or, roughly, as far as from New York to Buenos Aires or Petrograd, or from London to Cape Town or Bombay, by land and water, over mountain and plain, through prairie and forest, the British Empire and the United States meet each other face to face, without thought of defense or fear of aggression. In all that distance the only sentinels that guard the line are the silent monuments erected by the joint action of the two nations; the only vessels are the unarmed ships which carry the commerce of their common waterways; the only weapons are the woodman's ax, the huntsman's rifle, and the tools of fruitful trade and agriculture. Peace reigns from end to end as profound and undisturbed as the quiet of the primeval forest that still clothes many reaches of the boundary line. It is a peace, moreover, not of monotony or of solitude, for a journey along the windings of this far-flung frontier is an epitome of the industrial and commercial life of the two countries.

## THE CANADIAN-UNITED STATES BOUNDARY—ITS COURSE BRIEFLY TRACED

Let us consider the variety of scene and circumstance which such a journey would present. The traveler who would follow the boundary begins at a point in the Atlantic Ocean in the Grand Manan Channel, in latitude 44° 40′ and longitude 67° approximate, and enters the Bay of Fundy with its gigantic tides (25 feet at the entrance, 50 feet at the head), passing Quoddy Head, the most easterly point in the United States; thence through a narrow channel past the towns of Lubec and Eastport, busy with their herring fisheries, up the Passamaquoddy Bay and into the St. Croix River. This river he follows to its source up Monument Brook and thence 77 miles due north, through a rolling country famous for potatoes, to the middle of the St. John River. Ascending the main channel of the St. John he finds himself in a beautiful and fertile valley filled by French-

* An address delivered before the American Geographical Society on April 25, 1922.

speaking inhabitants and, having reached the St. Francis River, he pursues the devious windings of that forest stream to Lake Pohegamook, in latitude 47° 28′, longitude 69° 15′; still in the forest shadow, he reaches the St. John again and follows its southwest branch to the crest of the watershed dividing the waters of the Kennebec, Androscoggin, and Penobscot Rivers from the tributaries of the St. Lawrence. Clinging to this watershed, he encounters Hall's Stream and is guided by it to the 45th parallel of latitude, surveyed in 1774 by Valentine and Collins for the then British Governors of New York and Canada as the line between those provinces.

Westward then with the Valentine-Collins line, crossing Lake Memphremagog and the Richelieu River, the traveler comes to the old Indian village of St. Regis on the banks of the majestic St. Lawrence and, breasting the swift current of that powerful stream, follows it past hamlet and village and town, through the beautiful Thousand Islands with their hundreds of summer homes, until it enters Lake Ontario at Cape Vincent. Crossing Lake Ontario, the line runs up the Niagara River, dividing the great waterfall impartially into the American and Canadian Falls, and reaches the outlet of Lake Erie near the American city of Buffalo, a port whose commerce, inland though it be, compares with such ocean ports as Glasgow. Then to the west end of Lake Erie, up the Detroit River between the cities of Detroit, Michigan, and Windsor, Ontario; through Lake St. Clair to Lake Huron; over that lake to the Sault St. Marie with its great locks, which evil minds during the late war plotted to destroy, and out into the vast unsalted sea of Lake Superior. The voyager through the Great Lakes meets all along the way an unending stream of vessels bringing down the grain of the western wheat fields and the iron and copper of the Lake Superior basin and carrying back in return fuel and supplies for all the broad northwestern region.

The boundary leaves Lake Superior at the mouth of the Pigeon River, over the route taken in early days by the adventurous brigades of the fur-trading companies, and makes by South Fowl Lake, Lac La Croix, Rainy Lake, and the Rainy River to the northwesternmost point of the Lake of the Woods, where it turns due south twenty-six miles to an intersection with the 49th parallel of latitude. Here uncertainty and deviation disappear. Regardless of obstacle it plunges to the west, across the swampy timbered country of the Roseau River, then over many miles of fertile and untimbered prairie to the Turtle Mountains, rising one thousand feet above the plain. Here are trees again, but after thirty-five miles of grateful shade the traveler descends to a semi-arid and treeless plain extending to the foothills of the Rocky Mountains with their forested slopes. The divide is crossed at an elevation of 7,300 feet; and after a succession of rivers and mountains, glaciers and lofty summits, much of the time through heavy timber, one comes to level country in approaching the sea and reaches salt water at the Gulf of Georgia; down the Gulf, though Haro Strait and Juan de Fuca Strait, and the end of the line is found in

the Pacific Ocean at latitude 48° 30′ and longitude 124° 40′, 3,900 miles from the point of departure.

## The Alaskan-Canadian Boundary

There are, however, 1,500 miles still to traverse, which are by no means the least difficult of the journey. Five hundred miles north of the Strait of Fuca the Alaskan-Canadian boundary begins at Cape Muzon, the southernmost point of Prince of Wales Island. Crossing the sound known as Dixon Entrance, it follows the Portland Canal, so named by Vancouver, to its head near Mts. Gladstone and Johnson; then by straight lines drawn from peak to peak roughly following the windings of the coast, encountering the greatest glaciers in all the world outside the polar regions, and crossing the Unuk, Stikine, Whiting, and Taku Rivers, it mounts the White and Chilkoot Passes, over which the rush of gold seekers made their eager way into the Klondike, and pauses at the towering height of Mt. St. Elias, perhaps, with its 18,000 feet, the most magnificent boundary post in all the world. Two miles northeast of Mt. St. Elias the line reaches the 141st meridian and pursues it over barren mountain ridges, trackless glaciers, and fields of driven snow, passing the White, the mighty Yukon, and the Porcupine Rivers, to the Arctic Sea.

## Historical Scenes Associated with These Borderlands

Many sorts and conditions of men are to be encountered in these 5,400 miles of travel, from the fishermen of the eastern coast to the gold hunters of the Yukon, and, whether among the woodsmen of Maine, the sailors and toilers of the Lakes, the herdsmen of the prairie, or the prospectors of the western mountains, one can find ample material for stories of adventure and romance. Still more thrilling would the recital be if one should turn the pages of history and read what it has to tell of the border in the days when discovery was new. Great names flash out like meteors from every page and deeds of daring as bold as ever poet has sung. Starting in the East, the story would take up the voyage of Sebastian Cabot to Newfoundland in 1497 and of the Frenchman, Cartier, to the St. Lawrence in 1534; the journeys and labors of Champlain and his winter with De Monte on the Isle de St. Croix; and, pressing further west, the discoveries of the indomitable La Salle on the Lakes and the Mississippi. It would tell of the settlements by the English, the Mayflower and Plymouth Rock, Sir William Alexander and his Scotch in Nova Scotia; and would go on to describe the long and bloody warfare between France and Great Britain for supremacy on the continent. Into the picture come the painted figures of the warlike Iroquois, the five confederate nations of Mohawks, Oneidas, Onondagas, Senecas, and Cayugas, who formed, with their 2,500 fighting men, perhaps the most effective barrier to the southward march of the French. And we should see the long contest terminated forever on the Heights of Abraham by Wolfe

and Montcalm, whose joint monument in the city of Quebec finely records that "fate gave them a common death, history a common fame, and posterity a common monument." Then the American Revolution arrives upon the scene; Ethan Allen and his "Green Mountain Boys" pounding at the gates of Fort Ticonderoga with their demand for its surrender "in the name of the Great Jehovah and the Continental Congress;" the loyalists of New England hurrying across the border to join their comrades in Nova Scotia and the North; while Montgomery makes his ill-starred effort to repeat the successes of Wolfe against Quebec.

No less moving, although the stage is filled perhaps by fewer figures, is the story of the Pacific, dating from the day when Balboa marched his men into the surf at Darien and proclaimed the sovereignty of Spain over the broad waters of the new sea "for all time, past, present, or to come, without contradiction . . . north and south . . . from the Pole Arctic to the Pole Antarctic." Up the coast crept the Spaniards, Maldonado, Mendoza, Nuño de Guzman, Ferrelo, and the rest, including Cortes himself and Juan de Fuca, whose reputed voyage of 1592 is commemorated by the Strait that bears his name; and finally in the years 1774–1779 the memorable though belated voyages of Juan Perez, Heceta, and Bodega y Quadra in an effort to claim for Spain the entire Pacific coast. Meanwhile, however, in the year 1578 there had burst like a hurricane into the quiet waters of the Pacific the Englishman, Francis Drake, who so harried the ships and settlements of Spain that his name was spoken with horror for a century. Laden with Spanish booty, he too turned to the north and traveled as far as the 48th parallel in search of a safe passage home. Drake's Bay, a little north of San Francisco on the California coast, still marks the spot where he put in to refit after he had failed to find the Northwest Passage and was turning about for the Philippines, the Indian Ocean, the Cape, and home. Later on, the roster of explorers bears such names as the Russians, Bering and Chirikov in 1741; the Englishman, Captain Cook, greatest of navigators, 1778; and his worthy lieutenant and successor, Captain George Vancouver, 1792; La Pérouse, the Frenchman in 1786; the American, Gray, 1792, in his ship the *Columbia*, first to navigate the river that now bears her name; while overland to the Columbia basin there came through the trackless forest such men as Alexander Mackenzie, 1793, the discoverer of the great river of Northwestern Canada that bears his name; and Lewis and Clark (1804–1808) on their long journey for President Jefferson through the newly acquired Louisiana territory. Nor could one separate from the recital of discovery the tale of the fur traders; the fierce rivalries that flourished between the Hudson's Bay, the North-West, and the Russian-American Companies; their despotic rule over the far regions which they penetrated if they did not occupy; the story of such men as the Russian, Baranov, ruling from his camp at Kodiak for twenty years with an iron hand that brooked no opposition, exemplifying the Russian proverb that "God is high in the heavens and the Czar far away."

## The Treaty of 1783 Establishing the Boundary

The limits of time, however, must be recognized, and we must confine our attention to-night to the more prosaic, but I trust not wholly uninteresting, theme of the geographical line itself and the historic and diplomatic reasons for its present location.

The preliminary treaty which closed the American War of Independence was drawn at Paris in the year 1782 by Richard Oswald on behalf of Great Britain, and Benjamin Franklin, John Adams, John Jay, and Henry Laurens for the United States. The definitive treaty was signed in the following year by David Hartley for Great Britain, and Adams, Franklin, and Jay for the United States. The northern and eastern boundary lines of the latter were described as follows:

> That all disputes which might arise in future on the subject of the boundaries of the said United States may be prevented, it is hereby agreed and declared that the following are and shall be their boundaries, viz.: From the northwest angle of Nova-Scotia, viz., that angle which is formed by a line drawn due north from the source of St. Croix River to the Highlands; along the Highlands which divide those rivers that empty themselves into the River St. Lawrence, from those which fall into the Atlantic Ocean, to the northwesternmost head of Connecticut River; thence down along the middle of that river to the 45th degree of north latitude; from thence, by a line due west on said latitude until it strikes the River Iroquois or Cataraquy; thence along the middle of said river into Lake Ontario, through the middle of said lake until it strikes the communication by water between that lake and Lake Erie; thence along the middle of said communication into Lake Erie, through the middle of said lake until it arrives at the water communication between that lake and Lake Huron; thence along the middle of said water communication into the Lake Huron; thence through the middle of said lake to the water communication between that lake and Lake Superior; thence through Lake Superior northward of the Isles Royal and Phelippeaux, to the Long Lake; thence through the middle of said Long Lake, and the water communication between it and the Lake of the Woods, to the said Lake of the Woods, thence through the said lake to the most northwestern point thereof, and from thence on a due west course to the River Mississippi; . . . East, by a line to be drawn along the middle of the River St. Croix, from its mouth in the Bay of Fundy to its source, and from its source directly north to the aforesaid Highlands which divide the rivers that fall into the Atlantic Ocean from those which fall into the River St. Lawrence.

The piously expressed purpose of the signers to prevent all future disputes reads, in the light of subsequent events, like the prohibition against litigation so beloved by gentlemen who draw their own wills, for hardly was the ink dry upon the treaty before disputes arose in reference to the boundary. In large part uncertainty was unavoidable. The map which the negotiators had before them was one made by John Mitchell in the year 1755 and, although not bad for its day and time, was sadly lacking in accurate detail. A veteran who had fought through the American Civil War on the side of the South was once asked what was the chief lesson he had carried away from that experience, to which he replied that it had made him "forever damned suspicious of these popular movements." If the history of the boundary teaches no other lesson, it should at least warn treaty makers

to be forever suspicious of paper boundaries based upon insufficient surveys.

## Disputes in Reference to the River St. Croix

The first of these disputes concerned the identity of the River St. Croix, fixed by the treaty as the eastern boundary. There were three rivers which emptied into the Bay of Fundy at short distances from each other, viz., the Cobscook, Schoodic, and—fifty miles farther east—the Magaguadevic. The British authorities insisted that the middle river, the Schoodic, was the true St. Croix, while the Americans contended for the Magaguadevic. The difference became acute when Nova Scotia proceeded to grant land on the eastern bank of the Schoodic to loyalist refugees from the states, and Massachusetts, vigorously protesting, requested the Governor of Nova Scotia to recall "those subjects of His Majesty who have planted themselves within this commonwealth." To this the Governor of Nova Scotia firmly replied that Great Britain held to the Schoodic. With matters in this posture, America proposed the appointment of a Commission to settle the question, and in 1794, under the Jay-Wyndham Treaty, a joint commission of three was erected for the purpose. The Indian aborigines proved unsatisfactory witnesses, for they testified or were quoted impartially in favor of all three rivers; but excavations at the mouth of the Schoodic disclosed the remains of the Sieur De Monts' winter camp of 1604 and conclusively identified it as the St. Croix of Champlain.

It still remained, however, to determine the source of the St. Croix, as the point from which the due north line was to be drawn, and it appeared that not far from its source the Schoodic—henceforth to be known as the St. Croix—divided most perversely into two branches, an eastern and a western. Of these the former was the larger and therefore entitled to be considered the main stream; but to it the Indians had given the name of Chiputneticook, while the western kept the name of Schoodic. Without going into further detail, suffice to say that the commissioners decided for the eastern branch to its remotest spring, and it was and is so ordered.

If I were asked in what spirit this decision was accepted, perhaps I could do no better than recall the fact that during the war of 1812 the inhabitants on both banks of the St. Croix observed by common consent a strict neutrality. Some years later an official in charge of a powder magazine in the Canadian town of St. Stephen received from the Dominion or Provincial Governor a requisition for the powder under his control. He was constrained shamefacedly to reply that all the powder which the magazine contained had been loaned by him to the town of Calais, across the river, for a Fourth of July celebration and had not yet been returned. Commercially, matters have gone still further, for today these two cities are both supplied with water and electric light from works located on the Canadian side and run by a Canadian company, while their tramcars are operated by an American company with power generated in the United States.

## Settlement of the Maine-New Brunswick Line

I must ignore the dispute over the ownership of the islands in Passamaquoddy Bay, which was finally settled by a joint commission under the Treaty of Ghent, Great Britain getting rather the best of it, and go on to the much more important question of the line "due north from the source of the St. Croix River to the Highlands . . . which divide those waters that empty themselves into the River St. Lawrence from those which fall into the Atlantic Ocean." Here we come to the threshold of actual war. The source of the St. Croix has been fixed; but where are the Highlands and where is the corresponding northwest angle of Nova Scotia?

Perhaps the worthies who signed the Treaty of Paris believed that a definite range of more or less mountainous highlands existed along the southern slopes of the St. Lawrence, although the word may be fairly taken to mean lands high enough to form a watershed; but the apple of discord was thoughtlessly flung by an American, James Sullivan, who writes in 1802 to James Madison, afterwards President but then Secretary of State, that "Commissioners have traversed the country in vain to find the Highlands designated as a boundary." This Madison repeated to Minister King, in London, with instructions to negotiate for a joint commission, thus admitting the existence of doubt upon the subject and conceding a point which it was impossible to regain. Henceforth the British contended for Mars Hill, an elevation but forty miles north of the St. Croix, as the true northwest angle of Nova Scotia, while the Americans insisted, in vain as the event proved, that the Highlands of the treaty were the watershed far to the north, between the tributaries of the St. Lawrence and the headwaters of the Restigouche. The controversy was destined to endure with increasing bitterness for over forty years. The crux of the matter, from the British point of view, was an all-British overland route from Halifax to Quebec, which the American claim, if successful, would intercept; while the Americans, and more especially the States of Maine and Massachusetts, stood stiffly on a strict construction of their treaty rights.

After some abortive negotiations a joint commission was finally set up under the Treaty of Ghent to determine and mark the boundary from the source of the St. Croix to the St. Lawrence. It held its first meeting at St. Andrews, New Brunswick, in September, 1816, and its last in New York, in April, 1822, but had nothing better to report, after discussions "characterized by not a little acrimony," than complete disagreement. There followed the usual bickering between the rival governmental authorities in the disputed area, and at last, in 1828, a convention was signed in London, submitting the question to the King of the Netherlands as arbitrator. On January 10, 1831, that monarch rendered his award. He decided that the term "Highlands" applied to land, not necessarily hilly, which divided waters falling in both directions; but he held the evidence insufficient to support a decision in favor of either contestant and recommended accordingly a line of conven-

ience which gave Great Britain 4,100 square miles of the 12,000 square miles in dispute, and assigned the remaining 7,900 to the United States.

President Andrew Jackson was inclined to accept the award and indeed regretted afterwards that he had not done so, but the States of Maine and Massachusetts insisted that it was decision and not compromise which they desired; the Senate of the United States took their point of view, with the result that this chance for a settlement was lost. After this matters went rapidly from bad to worse. While statesmen negotiated the people of the border took things more and more into their own hands. Persons seeking to hold elections in the Madawaska settlement under Maine laws were arrested by New Brunswick; a Canadian justice of the peace attempting to execute process was arrested by the New Hampshire militia; and an officer taking the census for Maine in the Madawaska settlement was arrested by the New Brunswick authorities. Word came that timber was being cut on a large scale, and Maine sent a posse to arrest any Canadians guilty of what she believed to be a trespass. The three leaders of the posse indiscreetly put up for the night at a house three miles distant from their followers, and this error of judgment led to their being seized and thrust into prison by the very Canadians whom they themselves were seeking; but as a counterblow the provincial "warden" McLaughlin was arrested by the posse and taken to prison at Bangor, Maine. Both sides soon released their captives on parole, but passions were high, and there followed the bloodless adventure known as the Aroostook War. Maine marched her militia into the disputed area, threw up fortifications, and appropriated $800,000 for military operations; and Congress, not to be outdone, appropriated $10,000,000 for war purposes and authorized the President to call out the militia of the several states and raise 50,000 volunteers. Fortunately, when matters were at this height, General Scott, of the United States Army, was sent to the scene and succeeded in arranging a *modus vivendi* which averted any clash of arms. It was agreed "that the civil posse of Maine should retain possession of the valley of the Aroostook, the British denying their right; the British authorities retaining possession of the valley of the upper St. John, Maine denying their right."

In 1841 Daniel Webster became Secretary of State; a year later Great Britain sent to Washington, at his suggestion, Lord Ashburton, the son of Sir Francis Baring, founder of the famous house of Baring Brothers and Company, with power to negotiate a settlement. The states of Maine and Massachusetts reluctantly despatched commissioners to participate. It was not all easy going. Webster writes to Edward Everett, then Minister in London: "Our movement for the last ten days, if any has been made, has been rather backward. The boundary business is by no means in a highly promising state, so many obstacles arise not only between us and England but between us and the Commissioners and the Commissioners of the two states themselves."

Perseverance had its reward, however, and an agreement was reached;

the line suggested by the King of the Netherlands was adopted in the main, with some alterations by which the area awarded to the United States was substantially reduced. Maine and Massachusetts were placated, although not appeased, by money grants from the federal treasury, and the long contest was ended. Webster and Ashburton each earned the usual praise that attends the peacemaker. The former was accused in the United States Senate of "victimizing that deserted and doomed state," Maine; and Lord Palmerston, in England, styled the treaty "Lord Ashburton's Capitulation" and recommended that he receive a new title as "Earl Surrender," declaring him, because of his American wife, "a most unfit person for the mission upon which he had been sent."

### The Battle of the Maps

The episode cannot be dismissed without some reference to the famous Battle of the Maps.[1] Jared Sparks, an American historian, while making some researches in Paris, found in the winter of 1841–1842 a letter from Benjamin Franklin to Comte de Vergennes, French Minister of Foreign Affairs, in which he said, "I have the honor of returning herewith the map your Excellency sent me yesterday. I have marked with a strong red line, according to your desire, the limits of the United States as settled by the preliminaries between the British and American plenipotentiaries."

Following the trail, Sparks found among the French archives a map of North America made by d'Anville in 1746, with a red line drawn completely around the United States in such fashion as to concede to Great Britain on the Maine boundary more than she had ever claimed. He communicated his discovery to Webster, and, while there was nothing to identify the map as the one which Franklin had marked or anything whatever to indicate the unknown tracer of the red line, Webster used the map with great effect in procuring the ratification of the treaty by the Senate and its acceptance by Maine and Massachusetts. Afterwards, when charged with having overreached Lord Ashburton in the matter, he said:

> I must confess that I did not think it a very urgent duty on my part to go to Lord Ashburton and tell him that I had found a bit of doubtful evidence in Paris out of which he might, perhaps, make something to the prejudice of our claims and from which he could set up higher claims for himself or throw further uncertainty over the whole matter.

It is gratifying, however, to reflect that Great Britain lost nothing by the incident, for Sir Robert Peel, in the debate of March 21, 1843, said that the British Government had, prior to Lord Ashburton's negotiation, itself found the famous map at Paris and added, "there can be no doubt but that it is the map referred to by Mr. Jared Sparks; but we can trace no indication of connection between it and the despatch of Dr. Franklin."

On the other hand, there was at the time of the negotiation and doubtless still is, in the British Museum, another red-line map of unquestioned authenticity which belonged to King George III. It is one of the Mitchell maps of 1755, such as the peace commissioners used. It bears a red line showing the

boundary as claimed by the United States, with the endorsement in the King's own handwriting, "Boundary as described by Mr. Oswald." Concerning it Lord Ashburton writes to Mr. Webster on April 28, 1843:

> The map question now, fortunately, only interests historians. . . . I should have some curiosity to know how you unravel this, to me, inextricable puzzle; at present I will only say, what I know you will believe, that the discoveries here are quite recent and were wholly unknown to me when I was at Washington. Not but that I agree entirely with you that it would have been no duty of mine to damage the cause of my client, yet at the same time I perhaps went further in my protestations of ignorance than I otherwise should have done.

Let us leave it to be discussed by the shades of Webster and Lord Ashburton in the Elysian Fields, since neither party to the contest looks for a rehearing of the case.

## The Boundary through the Lakes and Westward to the Rockies

Of the boundary through the lakes and from Lake Superior to the Rocky Mountains I shall say but little, for there is bigger game ahead of us on the far side of the Continental Divide. You will remember, however, that the treaty of 1783 called for a line from the most northwestern point of the Lake of the Woods due west to the River Mississippi. Here again a surveyor was asked to accomplish the impossible, for the Mississippi, instead of running to the west of the Lake of the Woods, has its rise some 100 miles to the south. The line proposed vanished into the air. By a treaty negotiated in London in 1818, Robinson and Goulburn acting for Great Britain, and Gallatin and Rush for the United States, it was agreed to run a line from the most northwestern point of the Lake of the Woods due north or south, as the case might be, to the 49th parallel and then to follow that parallel to the Stony—now called the Rocky—Mountains. It was found that a line run due south twenty-six miles accomplished the purpose.

The selection of the 49th parallel involved no difficulty, for it was already recognized as a boundary line. At the peace of Utrecht, which closed the War of the Spanish Succession, Great Britain and France had undertaken a century before to fix their respective claims upon the American continent. France contended that her territory extended to the north to within fifty miles of Hudson Bay, while Great Britain insisted that the Hudson's Bay Company possessed the land to the 49th parallel. No express agreement was reached, but thereafter upon all English maps the 49th parallel was carried as the boundary line. In 1803 President Jefferson purchased from Napoleon, for $15,000,000, the Louisiana territory, perhaps the largest and most profitable real estate transaction on record; and, the United States having taken the place of France, the 49th parallel was accepted as the uncontroverted boundary line.

## From the Rocky Mountains to the Pacific

There was, however, a question which the negotiators of 1818 were unable to solve, as were also those who, four years earlier, had framed the Treaty

of Ghent; this was the boundary from the Rocky Mountains to the sea, which involved the whole thorny question of sovereignty over the Oregon country. Gallatin and Rush proposed that the 49th parallel should be accepted to the ocean, but the British negotiators intimated that they would be content with nothing short of the line of the Columbia River. It was an unbroken wilderness they were discussing, and aside from the voyages of discovery the only white men who had penetrated it were the fur traders, drawn there principally by the lure of the skin of the sea otter, who thus made his contribution to the march of civilization. It is easy to think that others are grasping when they desire what we covet ourselves. Perhaps you will care to listen to the remarks of Minister Rush upon the ambitions of his British confrères:

> Under this branch of the discussion might be seen power seeking its own augmentation. How strong the case for this reflection. A nation whose dominions in Europe established her in the front rank of power; whose fleets predominated on the ocean; who had subjects in Asia too numerous to be counted; whose flag was planted at the Cape of Good Hope and other posts in Africa; who had Gibraltar, and Malta, and Heligoland, enabling her to watch the Mediterranean and the Baltic; who had an Empire in the West Indies as in the East, and added to all, vast continental colonies in America—this nation was anxiously contending for territorial rights in deep forests beyond the Rocky Mountains and on the solitary shores of the northern Pacific.

And so, for want of agreement, it was written down that any country claimed by either party on the northwest coast of America westward of the Stony Mountains should be free and open for the term of ten years to the citizens of both powers without prejudice to their respective claims of sovereignty.

## Russian Part in the Contest

It was really a three-cornered contest, for Russia, having seated herself firmly in Alaska, was pressing down from the north, and the United States upward from the south, with Great Britain in between, struggling to maintain her footing on the coast. Spain ceded to the United States in 1819, by the Treaty of Florida-Blanca, whatever rights north of the 42nd parallel had inured to her by her voyages and discoveries and definitely retired from the field. In a sense it was Russia that forced the issue by the famous ukase of the Emperor, issued in 1821, which forbade "all foreign vessels not only to land on the coasts and islands" between Bering Strait and the 51st parallel "but also to approach them within less than 100 Italian miles" under penalty of confiscation of vessel and cargo. This was high language and naturally unacceptable either to Great Britain or America, who, as they have shown in very recent history, do not tamely accept a warning to keep off the open sea. Both promptly protested, Great Britain caring—as Canning frankly confessed—more about the principle involved than about the territory. "We negotiate about territory," he wrote, "to cover the remonstrance upon principle." Indeed, it may be questioned whether throughout the long controversy Great Britain was fully alive to the possibilities of the region. There

is a fable still extant to the effect that as late as 1846 Captain Gordon, a representative of Great Britain, became so disgusted because the Columbia River salmon would not rise to a fly that he reported to his Government that the "country was not worth a damn." However this may have been, the Russian ukase could not be borne. Negotiations were entered into accordingly, and in 1824 it was agreed between the United States and Russia that the citizens of the United States would not form settlements north of latitude 54° 40′ and that Russian citizens would form no settlements south of it. The next year Great Britain concluded a treaty which again limited Russia on the south by latitude 54° 40′ and on the east by the first range of mountains on the 141st meridian. This eliminated Russia and left Great Britain and the United States to fight it out.

## The Opposing Claims

Each of them continued to claim the entire territory, relying upon a sequence of events which may be briefly stated. The British claim was based on

1. The exploration by Captain Cook, in 1778, of the Pacific coast from latitude 43° N. to 70° N.
2. The establishment by British merchants, in 1788, of a trading post at Nootka Sound, which, although seized by Spain in 1789 together with two British ships that were anchored there, was restored by the treaty of 1790, which also recognized Great Britain's fishing and treaty rights in the Pacific.
3. The explorations of Vancouver in 1792–1794 of a part of the coast and waters of Juan de Fuca Strait and the Gulf of Georgia and the exploration by Alexander Mackenzie and fur-trading settlements by the North-West Company during the same period in the country north of the Columbia River.

The claim of the United States was based on

1. The discovery in 1792 of the Columbia River by Robert Gray, who entered and explored the river for twenty-three miles, giving it the name of his ship.
2. The expedition of Lewis and Clark, in 1803–1806, who came by the way of the Mississippi and Missouri Rivers across the Continental Divide to the headwaters of the Columbia, thence down the Clearwater, Snake, and Columbia Rivers to the Pacific Ocean.
3. The establishment in 1811 by the Pacific Fur Company, organized by John Jacob Astor of New York, of the fur-trading settlement near the mouth of the Columbia River, which was named Astoria. This had been taken by the British during the war of 1812 but was restored to the United States on the conclusion of peace.

In addition to these specific events the United States sought to strengthen its title by claim of succession to all rights held in the territory by either Spain, France, or Russia; in the case of the latter by renunciation, and under Spain and France by grant.

## The Oregon Treaty

Whatever merit there may have been in these conflicting claims proved in the end of minor importance, for it was effective occupation rather than historical rights that finally decided the question. Time was on the side of the Americans. Minister Rush knew this, in 1818, when he wrote that "in regard to those interests in the remote West, time is for the United States the best negotiator"; and Calhoun had the same thought in mind when he recommended, in 1843, a policy of "wise and masterly inactivity." No settlement having been reached, the arrangement for joint occupation was extended in 1827 for an indefinite period, subject to abrogation by either party on twelve months' notice; and a tide of American immigration set in which continued with increasing volume. As usual, missionaries were in the van, stimulated by the coming of four Indian chiefs to St. Louis seeking enlightenment. One thousand immigrants arrived in 1843; fourteen hundred more in the following year; and by 1846 there were in the disputed area 7,000 American settlers as against 400 British. A Provisional Government was erected by the settlers, to which the representatives of the Hudson's Bay Company somewhat surprisingly became parties. Meanwhile the Presidential election of 1844 came on, and President Polk was elected upon the famous campaign slogan of "Fifty-four-forty or fight;" in other words, a demand for the whole territory to the Russian line. Once installed, however, he announced that, while he stood for "Fifty-four degrees and forty minutes," he would refer any suitable proposition to the Senate; and Great Britain, acting upon the hint, offered the 49th parallel, reserving the whole of Vancouver Island and the free navigation of the Columbia. The offer was promptly accepted and concluded by the so-called Buchanan-Pakenham or Oregon Treaty signed at Washington on June 15, 1846, fixing the boundary as the 49th parallel from the Rockies to "the middle of the channel which separates the continent from Vancouver's Island, and thence southerly through the middle of said channel and of Fuca's Straits to the Pacific Ocean."

## San Juan Island

You would be glad, I am sure, to have the recital of this long-drawn-out controversy end here, but there still remains to be told the tale of the pig that was killed on San Juan Island. No sooner was the treaty signed than men began to ask which was the "channel that separates the continent from Vancouver's Island." Rosario Strait, said Great Britain, which, though it does not wash the continent, lies nearest to it; Haro Strait, said America, which is nearest to Vancouver; and between the two lay San Juan and a

group of smaller islands waiting to find out under which flag they belonged. The diplomats debated until the fateful year 1859, when an American citizen shot and killed, on San Juan Island, a pig belonging to the Hudson's Bay Company. He was threatened with arrest and removal to Victoria for trial, but his lusty cry for help reached a hot-blooded American general on the mainland, who promptly despatched troops to seize and occupy the island. Great Britain protested immediately, and the same General Scott who had watered down the Aroostook War was sent again to the scene of action and arranged a joint occupation of the islands by 100 men of each nation. An adjustment might have been hastened after this, but America —at least from 1860 to 1864—had other things to think about; and it was only in 1871 that a treaty was finally ratified submitting the question to the German Emperor for decision. His award, rendered in 1872, upheld the American contention that Haro Strait was "most in accordance with the true interpretation of the treaty" of 1846. Thus the threatened slayer of the pig was at last secure. But when the roll of animals that have made their place in history is called—the geese that saved Rome, the spider that re-inspired the Bruce, the cow that kicked over the lamp and started the great Chicago fire—is it too much to ask that the pig of San Juan Island may not be forgotten?

## The Alaskan Boundary

There remains but one more controversy to be considered. We must not stop until we have finally located the Alaskan boundary. In 1867 the United States purchased from Russia the territory of Alaska for $7,200,000, or at the rate of about two cents an acre. Some of the Congressional wise-acres of the day denounced it as an act of "ineffable folly" and "wanton profligacy," but it has not turned out so badly after all. America, of course took only what Russia held, and the latter had agreed with Great Britain in 1825 that the boundary between them should run from the southernmost point of Prince of Wales Island to latitude 54° 40′, ascending the Portland Channel to the 56th degree of north latitude, thence "follow the summit of the mountains situated parallel to the coast" to the 141st meridian, and with it to the Arctic Ocean; provided, however, that whenever the summit of the mountains referred to should "prove to be at the distance of more than ten marine leagues from the ocean" the limit between the two countries should be "a line parallel to the windings of the coast and which shall never exceed the distance of ten marine leagues therefrom." There was given to British subjects in perpetuity, by the sixth article of the treaty, the right to navigate all rivers and streams draining into the Pacific that crossed this coast strip, or *lisière*.

To the date of the American purchase this boundary line had never been traced upon the ground, and surveys made thereafter disclosed the disturbing fact that no continuous range of mountains parallel to the coast existed; on the contrary, the coast country was broken into an irregular "sea of mountains" over which it would be entirely impossible to trace a winding line ten

leagues from the coast. The result was, as the American Minister in London, Mr. Phelps, wrote to the Marquis of Salisbury in 1886, that "these treaties really give no boundary at all so far as this portion of the territory is concerned."

Languid efforts were made from time to time at settlement, but in 1896 an event occurred that made the question one of immediate importance. This was nothing other than the discovery of gold in the Klondike region, which provoked a tremendous inrush of eager gold seekers into the valley of the Yukon. The shortest route lay over the White and Chilkoot Passes; on their ocean side the towns of Dyea and Skagway sprang into existence along the Lynn Channel almost over night; and it became a matter of consequence, from the standpoint of customs duties and administration, to decide where the sovereignty of the region lay. A provisional boundary was agreed upon as a *modus vivendi*, and the two countries addressed themselves in earnest to the determination of their respective rights. To this end a convention was concluded in 1903, referring the question to a tribunal to be composed of "six impartial jurists of repute," three to be selected by the United States and three by Great Britain, who proved to be, on the part of Great Britain, Lord Alverstone, Sir Louis Jette, and Sir Allan Aylesworth and for the United States, Senators Root, Lodge, and Turner.

Reduced to its simplest terms the issue turned upon the meaning of the terms "coast" and "ocean," from which, under the treaty of 1825, the ten marine leagues were to be measured. The Alaskan coast hereabouts is inconceivably broken and rugged, penetrated by many deep and narrow bays, inlets, or channels into the heads of which pour numerous rivers, large and small. It resembles on the map a gigantic saw, with teeth projecting seaward far from the blade. In brief, Great Britain contended that the ten-league line should be measured from the outermost points of the coast, the tip of the teeth, with the result that the line would hardly strike the blade at all and the heads of nearly all the conspicuous bays and inlets would lie in British territory. America argued that the measurement must begin at tide-water wherever found, that is to say at the head of the deepest inlet, or where the saw tooth joined the blade. She sought to draw an unbroken land line ten leagues from any salt water.

The Commission sat on September 3, 1903, and rendered its decision on October 20. I shall not detail the reasoning by which able counsel defended the respective claims, except to say that the American representatives pointed out that if the British construction were correct, the clause of the treaty giving to British subjects the right to navigate the rivers and streams crossing the *lisière* was entirely unnecessary and meaningless, as all these rivers would empty on British territory into British waters. The tribunal, by a vote of four to two, Lord Alverstone voting with the Americans and the two Canadian members dissenting, decided substantially in favor of the American claim and drew a line joining certain designated peaks, which has been run and surveyed accordingly.

## Marking the Boundary

This completes the story, and from the Arctic to Cape Muzon, from the Pacific to the Atlantic, we have settled all the controversies of moment and have fixed the definite location of the boundary line. You will agree that a result, attained at the cost of so much effort, which means so much to the millions of people now living along the border and to the many millions more who will crowd it in the future, must not be exposed to the hazard of mistake or forgetfulness. I am glad to report that the duty to prevent this has not been neglected. This brings me to say a few words of the labor that has been and is being expended to mark the boundary for the benefit of this and of coming generations.

Under a series of treaties between Great Britain and the United States, dated in 1903, 1906, 1908, and 1910 respectively, the marking of the boundary from end to end has been assigned to two commissions; the land boundary to be marked by the International Boundary Commission—which is composed of two members, one Canadian and one American; the water boundary by the International Joint Commission on Waterways—composed of six members similarly divided. Some fugitive work had been done before. After the Webster-Ashburton Treaty of 1842, two gentlemen, Colonel J. E. Bucknall-Estcourt on behalf of Great Britain and Mr. Albert Smith for the United States, were designated to mark the line from the St. Croix River to the St. Lawrence. They went diligently about it, and erected some 700 triangular iron boundary posts, bearing on one face the legend, "Boundary, Aug. 19th, 1842;" on the second, "Lt.-Col. J. B. B. Estcourt, H. B. M. Comr.;" and on the third, "Albert Smith, U. S. Comr.;" but the posts are discreetly silent as to the names of the countries in interest. Perhaps one might characterize this as an example of monumental egotism. On the far western reaches of the boundary some posts had been erected, and also some mounds of earth and stone cairns, but the marking was inadequate where it existed at all; but now, as a result of the labor of these commissions, the line is thoroughly marked and monumented from end to end, except where the far northern snow fields make permanent marks impossible. On the land boundary five-foot posts of aluminium bronze, set in concrete, are stationed at intervals of from one to four miles, inter-visible, so far as practicable, and twenty-foot sky-line vistas have been cut through the forest; by water, range marks and finders are set along the visible shore at every turning point, and the line is charted through the broader waters. A series of accurate topographical maps, now almost finished, will complete a record made and signed under joint supervision that will always endure. The work has demanded infinite care, a vast amount of mathematical computation, and much labor both of body and of brain. Sad to say, it has not been accomplished without some loss of life in the rugged mountains and snows of the far Northwest. Of all this interesting stories might be told, did time permit. It is worth its cost, for however Great Britain and America may disagree

in the years that are to come, quarrels over their common boundary are at an end forever.

I return to the thought with which I began. In the thirties of the last century the United States was greatly concerned when it appeared that a resurvey of the boundary on the 45th parallel would prove that the one million dollars they had spent in fortifying Rouses Point, New York, at the end of Lake Champlain, had been expended upon British soil. The land was conceded to America, but there is no fortification there today. When the German Emperor awarded San Juan Island to the United States, in 1872, wild predictions were made of the forts the United States would build upon it to threaten the city of Victoria. A half century has come and gone, and even the marks of our joint military occupation have disappeared. Any member of the Canadian Parliament or American Congress who offered now a bill appropriating money to fortify the border would be regarded as mildly insane. In 1817, by a simple exchange of diplomatic notes, war vessels were banished from Lake Champlain and the Great Lakes, and the agreement, adjusted to meet the changing conditions of ship construction and revenue patrol, endures to this day. So it has been, so may it continue. Need I point the obvious moral? Is it not the old truth that trust is wiser than distrust, that confidence is nobler than jealousy, and that there are saner ways than war for nations to settle their disputes? Long may these neighbor commonwealths endure to teach that lesson to the world; and, if ever in the future passions should agitate or angry words divide them, may they turn for admonition and for warning to the Unguarded Boundary.

# ON THE LATE-GLACIAL AND POST-GLACIAL HISTORY OF THE BALTIC

By Ernst Antevs

Probably no other inland sea has as great and many-sided a scientific interest as the Baltic. There, owing to an unusually happy combination of circumstances, those *varve*, annual laminae of, clays and silts were deposited which enabled Gerard De Geer and Ragnar Lidén to obtain the exact geochronology of the last 13,500 years. Extensive alterations of level since the disappearance of the last land ice have changed considerably the outline of the Baltic. At first exclusively supplied with fresh water by the vanishing ice sheet, at times connected with the ocean by sounds, and at other times separated from it, it also underwent great changes in salinity. Along with these variations there were marked changes in climate, fauna, and flora. Since time immemorial the shores of the Baltic have been the home of the Nordic race; and so the long history of this sea is geological, geographical, and archeological.

In this article only those features of the physical history of the Baltic will be treated the interpretation of which has recently undergone fundamental modifications and which are essential to the solution of other problems. Thus, I shall deal mainly with the changes of level[1] and shall only touch upon the climatic evolution and the immigration and changes of fauna and flora.

## Amount of the Oscillations of Level in the Southern Baltic

The isobase of zero or line which marks the outer limit of late-glacial and post-glacial[2] upwarping of northern Europe—assuming sea level to have been constant—crosses Zealand in a northwest-southeast direction, touches Rügen and Pomerania, and continues in a curve towards the east-northeast.

Inside, or north, of this zero isobase at the disappearance of the ice the land was submerged. It has since undergone repeated elevations and subsidences. The net result is uplift.

Outside, or south, of the isobase of zero, on the contrary, the land lay higher than it does now. According to the German geologists North Germany then stood at the highest elevation it ever reached in all late-glacial

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[1] C. E. P. Brooks (The Evolution of Climate in North West Europe, *Quart. Journ. Royal Meteorol. Soc.*, No. 199, Vol. 47, 1921, pp. 173–194, London; reviewed by Ellsworth Huntington in *Geographical Review*, Vol. 12, 1922, pp. 126–130) largely bases his opinion of the causes of the climate of northern Europe in late Quaternary time on the old view of the changes of level.

[2] *Post-glacial* time, according to this chronology, begins the year after the bisection of the shrinking ice sheet at Ragunda in northern Sweden. The term *late-glacial* refers to the time occupied by the recession of the last ice sheet up to the event mentioned. See also the table on page 605 and the map on page 604.

and post-glacial time.[3] More probably the maximum elevation was attained somewhat after release from the ice, as seems to have been the case in southern New England.[4] Since the highest level was reached the region has probably undergone an almost uninterrupted slow subsidence down to its present level. As far as is known, there was no uplift during Ancylus time, i.e. the fresh-water stage of the Baltic in early post-glacial time.[5]

How much higher North Germany stood in late-glacial and early post-glacial time has not been determined, as the only possible records of this have sunk below the level of the sea. A minimum figure of the elevation at a somewhat later stage, however, has recently been determined. When the ice edge receded over southern Sweden the southern Baltic formed an ice-ponded lake, which was drained to sea level when the ice edge left Mt. Billingen, northeast of Gothenburg, and a lower region was uncovered. This lowering of the Baltic amounted to 17 meters.[6] Consequently, the thresholds in the southwestern Baltic, at that time, stood at least 17 meters above the sea. Since the Darsser Schwelle, between Falster and the German mainland, now reaches a depth of 18 meters, the southwestern Baltic region then stood at least 35 meters higher than now. When the ice was receding from southern Sweden, the tract probably stood somewhat higher than this, although no reliable evidence has been presented of a higher stand than 35 meters. Statements as to very high elevation, particularly in early post-glacial (Ancylus) time, have been found to lack real basis. Thus, in the southwestern Baltic terrestrial and semiterrestrial formations—peat, for example—have only been met with down to a depth of about 20 meters, viz. on the Oderbank and at Travemünde.[7] The greatest depths at which such formations have been found north of the isobase of zero are 14 meters at Copenhagen[8] and 9 meters south of Bornholm.[9] The alleged evidence from the southeastern Baltic that the topographical conditions in the Leba-Rheda valley,[10] north-

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[3] C. Gagel: Die sogenannte Ancylushebung und die Litorinasenkung an der deutschen Ostseeküste, *Jahrbuch Königl. Preuss. Geol. Landesanstalt zu Berlin*, Vol. 31, 1910, pp. 203–226.

Theodor Otto: Der Darss und Zingst. Ein Beitrag zur Entwicklungsgeschichte der Vorpommerschen Küste, *Jahresberich Geogr. Gesell. zu Greifswald*, Vol. 13, 1911–12, pp. 235–485; reference on pp. 312–316.

[4] Ernst Antevs: Recession of the Last Ice Sheet in New England, *Amer. Geogr. Soc. Research Ser. No. 11*, 1922.

[5] Gagel, *op. cit.*, p. 204.

Otto, *op. cit.*, pp. 310 and 321.

E. Geinitz: Diluvialstudien im östlichen Mecklenburg, *Archiv Vereins der Freunde der Naturgeschichte in Mecklenburg*, Vol. 66, 1912, p. 187. Rostock.

[6] G. Lundqvist: Den baltiska issjöns tappning och strandlinjerna vid Billingens nordspets, *Geol. Fören. Förhandl.*, Vol. 43, 1921, pp. 381–385. Stockholm.

[7] Gagel, *op. cit.*, p. 222.

Otto, *op. cit.*, p. 315.

[8] Ernst Antevs: Some Corrigenda, *Geol. Fören. Förhandl.*, Vol. 40, 1918, p. 892–893. Stockholm.

[9] K. A. Grönwall and V. Mitlhers: Kortbladet Bornholm, *Danmarks Geol. Unders.*, Ser. 1, No. 13, 1916; reference on pp. 236 and 244. Copenhagen.

[10] Alfred Jentzsch: Ueber einige Züge in der Oberflächengestaltung Westpreussens, *Zeitschr. Deutsch. Geol. Gesell.*, Vol. 42, 1890, pp. 613–618; reference on p. 617.

*Idem:* Das Präzisions-Nivellement Lauenburg-Neustadt-Rheda. Eine Studie zur Frage nach senkrechten Boden-Bewegungen, *Jahrbuch Königl. Preuss. Geol. Landesanstalt zu Berlin*, Vol. 33, 1912, Part II, pp. 367–384.

K. Keilhack: Die Stillstandslagen des letzten Inlandeises und die hydrographische Entwickelung des pommerschen Küstengebietes, *ibid.*, Vol. 19, 1898, pp. 90–152; reference on p. 145.

*Idem: Geol. Zentralbl.*, Vol. 22, 1915, No. 31.

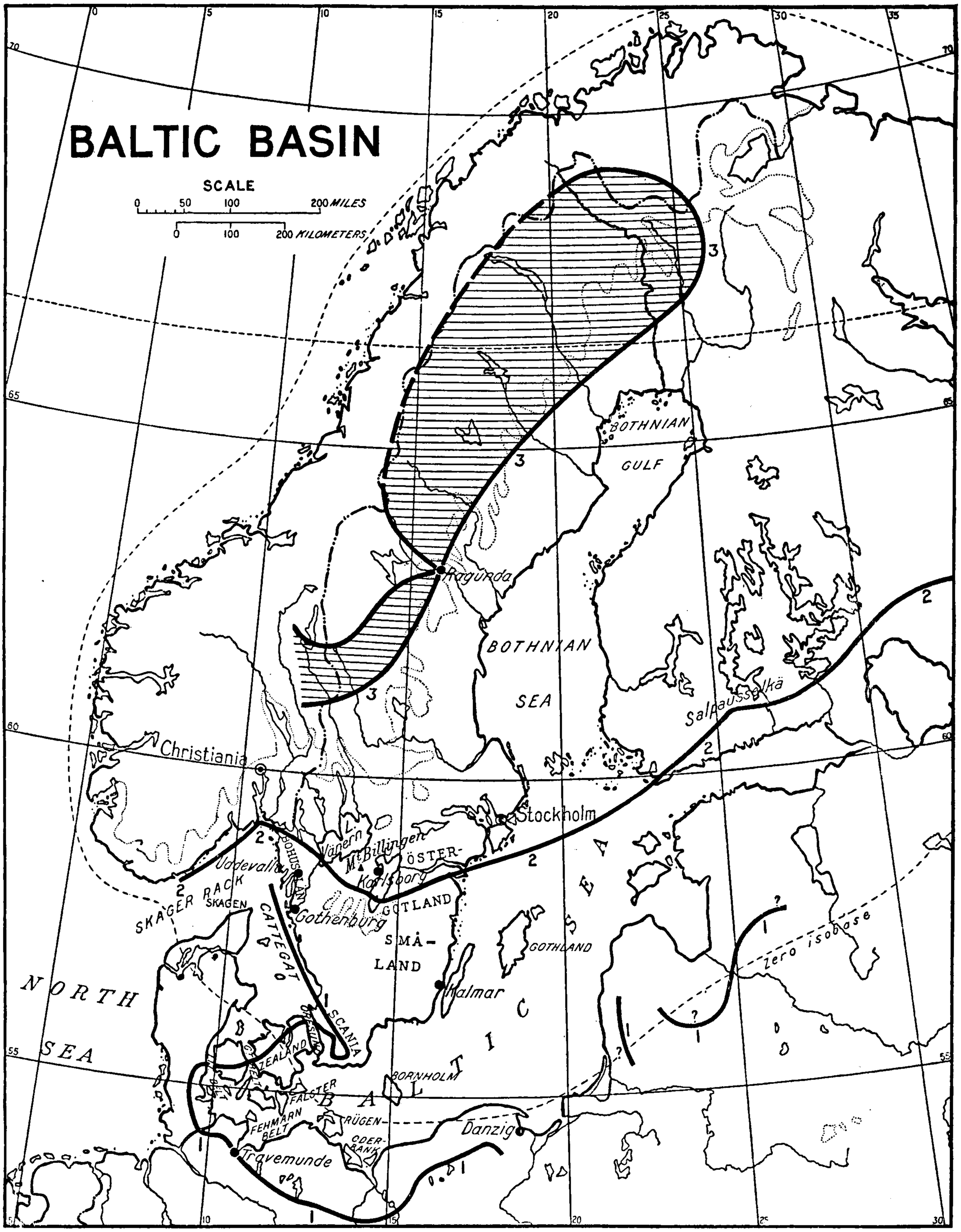


FIG. 1—Map illustrating the late-glacial and post-glacial history of the Baltic Basin. The numbered lines indicate the position of the ice edge at the beginning of (1) goti-glacial (after Gerard De Geer: Om naturhistoriska kartor över den baltiska dalen, *Pop. Naturvet. Revy*, 1914, pp. 189–200 and Pls. 1–4, Stockholm), (2) fini-glacial, and (3) post-glacial time respectively. Ice remnants in Sweden, at the beginning of the post-glacial epoch, are shown by shading. The light broken line is the zero isobase. (The base upon which these data are shown is Northwest Europe, No. 215, in Goode's Series of Base Maps, The University of Chicago Press, 1920; the scale is approximately 1:13,500,000.)

| Chronology (Gerard De Geer and Ragnar Lidén) | | | | Changes of Level in Bohuslän (Ernst Antevs) | Stages in the Baltic (Modified from Henrik Munthe and others) |
|---|---|---|---|---|---|
| 0 | — | — | A.D. 1900 | — | — |
| 1,000 | — | — | Recent | — | — |
| 2,000 | — | — | | — | Limnaea: salinity decreases |
| | | | | Present level reached | |
| 3,000 | — | — | | —Elevation | — |
| 4,000 | — | — | Post-glacial | — | — |
| 5,000 | — | — | | — | — |
| | | | | Submergence (Tapes) | Littorina: salinity twice that at pres- |
| 6,000 | — | — | | — | —ent; submergence |
| | | | | Elevation | |
| 7,000 | — | — | | — | — |
| | | | | Submergence | |
| 8,000 | — | — | | — | —Ancylus: fresh-water inland sea; submergence |
| | | | Bisection of ice remnant at Ragunda | Elevation | |
| 9,000 | — | — | Ice retreat from the Fenno-Scandian moraines (inclusive) to Ragunda | — | —Sea connection through central Swedish straits |
| | | | Fini-glacial | Submergence | |
| 10,000 | — | — | | — | —Drainage of last Baltic ice lake at Billingen |
| | | | | Elevation | South |
| 11,000 | — | — | | — | —Baltic ice lakes and |
| | | | Ice retreat from south Scania, the Danish Islands, and North Germany to the Fenno-Scandian moraines | Submergence Elevation | |
| 12,000 | — | — | | — | —fresh water inland seas |
| | | | Goti-glacial | Depressed to marine limit, | |
| 13,000 | — | — | Central Scania released from the ice about 13,500 years ago | —as released from the ice, but rising | — |
| 13,500 | — | — | Time represented in the outermost part of the zone unknown | | |

FIG. 2—Chronology for eastern and western Sweden. Intended to show the relationship between the principal events in eastern and western Sweden and to combine them with the De Geer-Lidén exact chronology.

The term goti-glacial is derived from Gothia, the modern Götaland or southern Sweden; fini-glacial has reference to the final stage of the ice recession.

The present surface salinity in the Baltic is: South of Scania 0.8 per cent, at Gothland 0.7 per cent, in the southern Bothnian Sea 0.5 per cent, and in the northern Bothnian Gulf 0.2 per cent. In the southern Öresund the surface salinity is 1.1 to 1.2 per cent, at Skagen 3 per cent and in the Atlantic 3.5 per cent.

west of Danzig, indicate an elevation in late-glacial time of at least 50 meters above the present seems to be illusory.[11] This is doubtless the case also with the evidence presented by Munthe [12] that the "river-channel-shaped depressions" in the Danish Belts and in the Öresund indicate the base of river erosion in Ancylus time; for Spethmann's[13] bathymetrical map shows clearly that these depressions cannot have been eroded by rivers, as they consist of series of narrow basins separated by thresholds which at some points are very shallow and broad. These depressions, as Gerard De Geer has orally pointed out, probably mark lines of fracture.

## Ancylus Lake—A Fresh-Water Inland Sea

In the beginning of the post-glacial epoch the Baltic was characterized by fresh water, as has been known for 35 years especially through Munthe's valuable studies of its subfossil fauna and flora. At the same time a well recorded and extensive transgression took place in the central and southern Baltic region. The fresh water proved in Munthe's opinion that the Baltic was a true lake separated from the sea. The Baltic of that time has therefore been called the Ancylus lake. The transgression has been explained by a more rapid rising of northern Scandinavia than of the southern part, by which the water masses were shifted southward causing the water level to rise there. This explanation assumes a very high elevation of the southern Baltic region.[14]

As the present writer [15] pointed out, however, the fresh water of the Ancylus lake can be explained without the assumption of its being excluded from the sea by referring it to an excessive supply of ice water from the ice sheet. This makes it unnecessary to accept the changes of level as set forth by Munthe, which are hardly acceptable in themselves and which disagree with evidence more recently obtained in western Sweden. A consideration of the conditions which govern the present salinity of the Baltic [16] will make clear the basis for this new view of it as a fresh-water inland sea during Ancylus time.

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[11] Gagel, *op. cit.*, p. 219.

E. Wunderlich: Postglaziale Hebung in Westpreussen und Hinterpommern, *Zentralbl. für Mineral., etc.*, 1914, pp. 464–468.

[12] H. Munthe: Studies in the Late-Quaternary History of Southern Sweden, *Geol. Fören. Förhandl.*, Vol. 32, 1910, pp. 1197–1293; reference on p. 1205. Stockholm.

[13] Hans Spethmann: Tiefenkarte der Beltsee, *Petermanns Mitt.*, Vol. 57, II, 1911, pp. 246–251 and Pl. 29.

[14] Munthe, *op. cit.*, p. 1205, Pl. 46B.

*Idem:* Studier öfver Gottlands senkvartära historia, *Sveriges Geol. Unders.*, Ser. Ca, No. 4, 1910; reference on pp. 36–38, 178, 205. Stockholm.

[15] Ernst Antevs: Post-glacial Marine Shell Beds in Bohuslän, *Geol. Fören. Förhandl.*, Vol. 39, 1917, pp. 247–425; reference on p. 257. Stockholm.

[16] Otto Pettersson: Resultaten af den internationella hafsforskningens arbete, *Kungl. Jordbruksdpt. Meddel. 14*, 1907; reference on p. 89. Stockholm.

*Idem:* Strömstudier vid Östersjöns portar, *Svenska Hydrograf.-biolog. Komm. Skrift.*, No. 3, 1908. Gothenburg.

*Idem:* Über Meeresströmungen, *Veröffentl. Inst. für Meereskunde*, No. 12, 1908. Berlin.

Otto Krümmel: Die deutschen Meere im Rahmen der internationalen Meeresforschung, *Veröffentl. Inst. für Meereskunde*, No. 6, 1904.

*Idem:* Handbuch der Ozeanographie, 2 Vols., Stuttgart, 1907, 1911; reference in Vol. 1, p. 350.

## Present-day Salinity of the Baltic

At the present time the Baltic is connected with the ocean by the Öresund and the Fehmarn Belt.

The south Öresund, 8 meters deep, generally allows only an outward-flowing current to pass through. During long and continued northwesterly winds, however, a turn of the current sometimes sets in which carries some sea water across the threshold.

The Fehmarn Belt, on the sill between Falster and Darsserort, is at most 18 meters deep. Here a surface current usually flows outward to the Cattegat, while a bottom current flows inward to the Baltic. The outgoing surface current is formed by a mighty wedge-shaped layer of Baltic water of a homogeneous salinity of 0.7–0.8 per cent. The incoming undercurrent is brought about by a thin wedge of heavier water of 0.9–1.2 per cent salinity, as often as this is forced across the threshold by the excess of atmospheric pressure on the North Sea over that on the Baltic. When the conditions of atmospheric pressure are reversed the undercurrent does not get through, and the outgoing Baltic waters occupy the whole cross section of the channel.

To what degree and how rapidly the salt water which thus comes in across the thresholds is mixed with the brackish water of the Baltic is not yet fully made out; for, in spite of the fact that a lively circulation takes place in the inland sea, the presence of salty bottom layers, particularly, proves that the mixing is very incomplete. As it seems probable that the mixing of two water masses is rendered more difficult by great contrasts in their gravity or salinity, the mixing was probably still less effective in late-glacial and early post-glacial times than now.

In this connection the present conditions in lake Mälaren, at Stockholm, are significant because they are so well known, and because this lake is related to the Baltic much as the Baltic during long periods in late-glacial time was related to the Western Sea. It must be kept in mind, however, that the circulation and the mixing of the waters in Mälaren, no doubt, are less than was and is the case in the large Baltic.

The channel between Mälaren and the Baltic, the Norrström, in Stockholm, is exceedingly short and narrow, and the threshold lies about 4 meters below sea level.[17] Mälaren has fresh water and the Baltic brackish. If, as sometimes happens, the water level of the Baltic rises above that of the lake, brackish water enters. This water, however, does not mix with the fresh water but essentially forms well-defined beds in the upper water layers which are sooner or later carried off by the outward-flowing current. To some extent the brackish water comes to rest on the bottom in the deepest parts of the basin. Such brackish bottom layers occur as far as 20 kilometers (12.5 miles) up the lake and are removed only when storms agitate the water so strongly that the brackish beds rise to the surface. Under

17 Klas Sondén: Vattnet i sjoar och vattendrag inom Stockholm och dess omgifningar, *Bihang 2 till Stockholms stads hälsovårdsnämnds årsberättelse 1910*, Avd. 1, 1912. Stockholm.

normal conditions during 1909–1911 the proportion of salt in the deep holes in the part of Mälaren called Ekeröfjärden, 10 kilometers west of Stockholm, was 0.2 per cent; while in the Trälhavet, a bay of the Baltic 20 kilometers northeast of Stockholm, at a depth of about 10 meters, the proportion was 0.5 per cent.

We may now apply these principles to the conditions which obtained in late-glacial time.

## Application to Conditions in Late-Glacial Time

When the land ice left the southern part of the Baltic basin, it was of course replaced by fresh ice water. As the recession went on, the growing lake received enormous supplies of fresh water from its large drainage area. By the tilting of the land the waters were shifted southward, creating strong outward-flowing currents through the Öresund, the sounds in central Sweden, and perhaps in other places, diluting the water in the Western Sea and holding back the incoming currents.

When the receding ice border uncovered the Fehmarn Belt, that channel stood at a high level. After the highest elevation had been reached it was submerged, until it finally became so deep that a salt undercurrent could force its way through the strait into the Baltic basin. Judging from the present conditions at the entrances to the Baltic, its depth was then more than 10 meters, perhaps 15 meters. Consequently this may have happened in late Ancylus time, for the region had reached its present level at the maximum of the Littorina subsidence, as shown by shore lines, shell beds, peat bogs, etc.

The changes in the level of the southern Öresund are little known, but it seems likely that the region in late-glacial and early post-glacial times for long periods lay higher than now. At the beginning of the fini-glacial epoch, indeed, it stood considerably higher.

During late-glacial and early post-glacial times, consequently, it is probable that no sea water passed in through the Fehmarn Belt and only an inconsiderable quantity through the Öresund. Incomparably more brackish water must have forced its way in through the sounds which, in fini-glacial time, existed in central Sweden. These sounds were wider and several times as deep and, furthermore, were situated directly opposite the Skagerrack and North Sea. They, however, were relatively short-lived and had, as indicated by the subfossil fauna and flora as well as by the sediments, only inconsiderable and local influence on the salinity of the Baltic.

After coming in through the straits, part of the brackish water probably settled down in the nearest deep basins and remained there for a long time more or less unmixed with the fresh water. Another part spread along the bottom over the central Swedish lowland and, probably, the southwestern district of Finland. Still another part was immediately carried off again by the strong outflowing current.

With the brackish water came a scanty marine fauna and flora, represented by forms which can endure strongly diluted water and which no doubt lived principally in the saltiest bottom layers: *Portlandia* (*Yoldia*) *arctica*, a few foraminifera, *Phoca groenlandica*, *Cottus quadricornus*, *Gammaracanthus loricatus*, *Idothea entomon*, etc., and a few diatoms.[18] Portlandia was represented by a stunted form indicative of too high temperature and too diluted water. It was limited to the Mälar depression and lived close to the receding ice border. In the Stockholm region it existed for less than 100 years.[19] Consequently, it is unfortunate to distinguish, as Munthe has, a stage in the history of the Baltic as "Yoldia time."

When and by which way some marine forms found at Kalmar, in southern Sweden, immigrated,[20] and what rôle the connection of the Baltic with the White Sea via Ladoga and Onega played, seems to be too little known to be discussed.

As Scandinavia underwent a mighty upheaval the central Swedish sounds grew shallow, and the inflow of brackish water became less and less. By storms and circulation the brackish water was gradually brought up into the upper water layers and thence carried out to sea. Finally, during Ancylus time, the Baltic, even in the central Swedish region, became practically fresh.

The highest salinity of the Baltic, reached during the Littorina subsidence, was, as far as known, synchronous with the one time when both the Darsser Schwelle and the threshold in the southern Öresund lay so deep that salt undercurrents could normally pass across them. The Fehmarn Belt then stood at about the same level as now, or 18 meters deep, while the southern Öresund lay about 5 meters lower than now, i.e. was 13 meters deep. The water outside the threshold, in the Cattegat, was at that time, as shown by the subfossil molluscan fauna, salter than during any other late-Quaternary phase and considerably warmer than at present. Its high temperature and relatively low gravity was, probably, an essential reason for its effective mixing with the Baltic water.

When the Öresund region and the Danish peninsula rose, the salinity of the Baltic slowly decreased to its present percentage.

So it seems quite possible that the surface layers and the main mass of the Baltic during Ancylus time consisted of fresh water, even though there had been connection with the ocean during most of the time since the Danish Islands became free of ice. The transgression of Ancylus time within the Baltic can be explained by subsidence of land instead of by a rising of the water within a closed basin during a mighty and long-continued upheaval and tilting of the land. This view is directly supported by recent observations in western Sweden. At several points around lake Vänern, Von Post[21]

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18 See H. Munthe: Studies in the Late-Quaternary History of Southern Sweden, *Geol. Fören. Förhandl.*, Vol. 32, 1910, pp. 1197–1293; reference on p. 1236. Stockholm.

19 Gerard De Geer: Finiglaciala Yoldia-relikter, *Geol. Fören. Förhandl.*, Vol. 35, 1913, p. 307. Stockholm.

20 See Munthe, *op. cit.*, p. 1235.

21 Lennart von Post: Ett finiglacialt granfynd i södra Värmland, *Geol. Fören. Förhandl.*, Vol. 40, 1918, pp. 19–25. Stockholm.

has found an old shore line which undoubtedly corresponds to the limit of transgression in the Baltic region during Ancylus time and thus proves that the Ancylus transgression was due to a sinking of land. In the Christiania region and in Bohuslän there are similar evidences of a subsidence contemporaneous with the Ancylus transgression.

## Changes of Level in the Baltic Basin

### Region South of the Isobase of Zero

The South Baltic and North Germany, south of the isobase of zero. probably stood highest shortly after they were relieved of the ice. As has been explained (p. 603), the exact elevation is unknown but was probably more than 35 meters above the present. Since the withdrawal of the ice North Germany seems to have undergone an almost uninterrupted slow subsidence, until the present level was reached at the climax of the Littorina submergence.

### Central Baltic Region

It seems evident that similar changes in level took place simultaneously in western and eastern Sweden. Western Sweden, lying on the sea, affords the decisive evidence as regards the direction of the movements.

In Bohuslän the following changes of level seem to have taken place.[22] When the ice uncovered the coast and the marine limit was recorded, an intense and extensive uplift was already in progress. The elevation was followed by subsidence in late goti-glacial time, i.e. when the ice receded south of lake Vänern. At the end of the goti-glacial and beginning of the fini-glacial epoch the region once more was rising. This second emergence was interrupted by a fini-glacial sinking. During the latter part of the fini-glacial epoch the land rose for a third time, only to undergo a new submergence in early post-glacial time. After a fourth subsidence (Tapes submergence) the tract finally rose to its present level, which was reached at the beginning of the Iron Age, or about 500 B. C.[23]

The late goti-glacial subsidence is that one observed by De Geer[24] at Kapellbacken, Uddevalla, but dated by him wrongly, I think, as fini-glacial. The fini-glacial submergence here recognized is new. The early post-glacial subsidence has been recognized for some time in southeastern Norway but is new for Bohuslän. The Tapes submergence has long been known.

As pointed out, all these oscillations should have had their parallels in eastern Sweden, in the Central Baltic region.

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[22] Ernst Antevs: Senkvartära nivåförändringar i Norden, *Geol. Fören. Förhandl.*, Vol. 43, 1921, pp. 642–652 Stockholm.

[23] Otto Frödin: En svensk kjökkenmödding, *Ymer*, Vol. 26, 1906, pp. 17–35; reference on p 33.

[24] Gerard De Geer: Quaternary Sea Bottoms in Western Sweden, *Geol. Fören. Förhandl.*, Vol. 32, 1910, pp. 1139–1195. Stockholm.

The goti-glacial subsidence has not yet been established within the Baltic, but we can expect to find it registered in northern Småland and southern Östergötland.

The fini-glacial submergence has also been proved on Mt. Billingen[25] and at Karlsborg on lake Vattern.[26] To this subsidence should be attributed, probably, also the well-marked shore line in southern Finland which Ramsay[27] has interpreted as the marine limit after the drainage of the Baltic ice lake at Billingen. This view seems to be supported by a newly discovered fact. At the northern end of Billingen Lundqvist[28] determined the limit of the Baltic ice lake at a height of about 149 meters, the marine limit at 132 meters, and the fini-glacial limit at 117–119 meters. The difference in the level between the Baltic and fini-glacial limits is, consequently, 30–32 meters; and that between the marine and fini-glacial ones 13–15 meters. At Karlsborg the Baltic limit lies at 153[29] and the fini-glacial at 118–123 meters.[30] The difference of level is 30–35 meters. On the inner Salpausselka in southern Finland Ramsay[31] found well developed shore lines, which he interprets as the marine limit, 31–34 meters below the limit of the Baltic ice lake; and a little north of the Salpausselkä he found other terraces, in his opinion marking an interruption in the drainage of the ice lake, about 12–13 meters above the shore lines just mentioned. Thus Ramsay's "marine limit" seems to be better conceived of as the fini-glacial limit, and his less developed terraces as the marine limit after the drainage.

The early post-glacial subsidence seems to be identical with the Ancylus transgression, which, I think, is now fully proved to be due to subsidence of land and which may be early post-glacial instead of fini-glacial, as has generally been assumed.[32]

The Tapes submergence on the west coast was contemporaneous with the Littorina subsidence in the Baltic.

## Southern Baltic North of the Isobase of Zero

The changes of level in southernmost Sweden and eastern Denmark have not yet been satisfactorily worked out. Thus, we do not know how many oscillations there have been nor what limits they have reached. However, it seems likely that the region has undergone all the oscillations that have occurred in Bohuslän and the central Baltic, and possibly earlier ones.

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[25] G. Lundqvist: Den baltiska issjöns tappning, *Geol. Fören. Förhandl.*, Vol. 43, 1921, p. 385. Stockholm. Also oral information by Dr. Simon Johansson.

[26] Lundqvist, *op. cit.*, p. 385.

[27] Wilhelm Ramsay: De s. k. marina gränserna i södra Finland, *Fennia*, Vol. 40, No. 7, 1917. Helsingfors. *Idem: Geol. Fören. Förhandl.*, Vol. 43, 1921, p. 495. Stockholm.

[28] Lundqvist, *op. cit.*, p. 382.

[29] Munthe, *op. cit.*, Pl. 47.

[30] H. Hedström: Om ändmoräner och strandlinjer i trakten af Vaberget, *Sveriges Geol. Unders.*, Ser. C, No. 188, 1901. Stockholm. Interpretation Lundqvist, *op. cit.*, p. 385.

[31] Ramsay, *Geol. Fören. Förhandl.*, Vol. 43, 1921, p. 495. Stockholm.

[32] Antevs, Senkvartära, p. 652.

## Central Region of the Upheaval District

When the peripheral districts were rising the more central ones were still depressed, nor do the later oscillations seem to have been contemporaneous in the whole district of upheaval. Thus, it is generally assumed that undulating movements of the crust of the earth advanced from all sides toward the center of the Scandinavian peninsula. Before reaching there, however, they seem to have lost themselves in an intense and unbroken elevation.[33]

[33] R. Lidén: Om isavsmältningen och den postglaciala landhöjningen i Ångermanland, *Geol. Fören. Förhandl.*, Vol. 33, 1911, pp. 271–280. Stockholm.

*Idem:* Geokronologiska studier öfver det finiglaciala skedet i Ångermanland, *Sveriges Geol. Unders.*, Ser. Ca, No. 9, 1913. Stockholm.

# THE EARTH'S CRUST AND ISOSTASY

By WILLIAM BOWIE
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It would be interesting to trace the different views which have been held, throughout past ages, regarding the condition of the outer and inner portions of the earth. For the purposes of this article it suffices to say that the belief that there is some difference between the outer portion and the inner portion of the earth and, therefore, a distinct crust, has always been maintained and is even today well fixed in our minds.

The earth's crust was originally pictured as a thin veneer floating on a molten interior. This conception must be modified to agree with modern results based upon accumulated geophysical observations and measurements made during the last few decades. For example, the observations made by seismologists, respecting the time of transmission of earthquake waves, prove that the interior substance is solid and not molten. Again, the observations upon the earth's tides as caused by the sun and moon indicate very clearly that the interior of the earth is not molten. It has been computed by investigators in seismology and tides that the earth, as a whole, has at least the rigidity of steel.

## DEFLECTIONS OF THE VERTICAL

It has been known for a long time that whenever an astronomic station connected with a net of triangulation is located near a mountain range, a large deflection of the vertical occurs. The *deflection of the vertical* is a term applied to the deviation of the plumb line (to which all astronomic observations are referred), from the normal to the mean surface of the earth or the ellipsoid. The triangulation, being a direct measurement made with instruments of precision and by highly skilled technicians, will carry geographic positions throughout the net with a very high degree of accuracy; but, when this triangulation is connected with astronomic stations which are influenced by mountains or other elevated masses of land, it will be found that the latitudes and longitudes carried by the triangulation will differ materially from the latitudes and longitudes determined by the astronomic observations.

What is the reason for this discrepancy? It is a well-known fact that a mountain mass attracts a particle just as the earth as a whole does. The attractions of the mountain mass and the earth are in proportion to their respective masses and inversely proportional to the squares of the distances of their centers from the particle on which they are acting. At-

tempts were made many years ago to correct the astronomic observations for the effect on the plumb line of the masses above sea level. The effect of applying the correction for the attraction of the mountain masses to the astronomic determinations was to make the difference between the astronomic and the geodetic positions have the opposite sign, although making it somewhat smaller numerically.

Archdeacon Pratt, in his geodetic investigations about the middle of the last century,[1] was forced to the conclusion that the mountains did not attract the plumb line to the extent that their masses and distances from the station would seem to justify one in believing. He expressed the view that the mountains acted as if there were vast voids below them. Of course, Pratt did not believe that there are actual voids; but he did believe that there is lighter matter (commonly called a "deficiency" of matter) under the mountains which, to a certain extent, neutralizes the attractive effect of the mountains themselves.

This idea had been hinted at by other writers[2] before Pratt but not in such a definite way, and it was some years before the idea gained much favor with geologists and geophysicists.

One of the early advocates of the theory that there is a deficiency of matter under mountain areas and that there is an excess of material or density under the oceans, was Major C. E. Dutton, of the U. S. Geological Survey. In 1889, in a paper before the Philosophical Society of Washington entitled "On Some of the Greater Problems of Physical Geology,"[3] he discussed at length the condition of the outer portion of the earth and strongly advocated the theory that at some depth below sea level there is a state of equilibrium or of equal pressure in the earth's crust. He believed that unit columns of the outer portion of the earth exert the same pressure on an imaginary surface at an unknown depth regardless of whether the columns are under the oceans, the coastal plains, the plateaus, or the mountains. Dutton used the term "Isostasy," meaning equal pressure, for this condition of crustal equilibrium.

Dutton's views on the subject of isostasy had a very stimulating influence on the geologists and physiographers of his time. Among others who wrote on the same subject were Gilbert, McGee, Putnam, Ransome, and

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[1] J. H. Pratt: On the Attraction of the Himalaya Mountains, and of the Elevated Regions Beyond Them, Upon the Plumb-Line in India, *Phil. Trans. Royal Soc. of London*, Vol. 145, 1855, pp. 53–100.

*Idem:* On the Influence of the Ocean on the Plumb-Line in India, *ibid.*, Vol. 149, 1859, pp. 779–796.

*Idem:* On the Deflection of the Plumb-Line in India Caused by the Attraction of the Himalaya Mountains and of the Elevated Regions Beyond; and Its Modification by the Compensating Effect of a Deficiency of Matter Below the Mountain Mass, *ibid.*, Vol. 149, 1859, pp. 745–778.

*Idem:* On the Constitution of the Solid Crust of the Earth, *ibid.*, Vol. 161, 1871, pp. 335–357.

[2] [Pierre] Bouguer: La figure de la terre, déterminée par les observations de Messieurs Bouguer et de la Condamine, etc., Paris, 1749, p. 364.

M. Petit: Sur la densité moyenne de la chaîne des Pyrénées et sur la latitude de l'Observatoire de Toulouse; *Comptes Rendus de l'Acad. des Sci.* [*de Paris*], Vol. 29, 1849, pp. 729–734.

R. G. Boscovich, De Litteraria Expeditione per Pontificiam Ditionem, Rome, 1755, p. 475; quoted in Isaac Todhunter: A History of the Mathematical Theories of Attraction and the Figure of the Earth, from the Time of Newton to That of Laplace (2 vols., London, 1873), Vol. 1, p. 313.

[3] *Bull. Philos. Soc. of Washington*, Vol. 11, 1892, pp. 51–64.

Willis.[4] Putnam was the first investigator to attempt to give a quantitative measure of the extent to which the earth's outer portion is in equilibrium.

In the early part of the present century Hayford began his remarkable isostatic investigations while connected with the U. S. Coast and Geodetic Survey, in charge of geodetic operations. He used the connected triangulation of the United States and numerous astronomic latitudes, longitudes, and azimuths in a study of the effect of the theory of isostasy, or the isostatic condition of the earth's crust, on the figure of the earth. Hayford issued two reports covering the details of those investigations,[5] which outline the methods employed by him and the conclusions reached. In addition to these reports, he has written a number of articles for the scientific press, dealing with the results of his investigations.[6]

In 1909 I was stationed at the office of the Coast and Geodetic Survey, Washington, D. C., as assistant to Hayford in the Division of Geodesy, and together we made a study of the effect of the isostatic condition of the earth's crust on the intensity of gravity.[7]

Important investigations, dealing with the earth's crust and the theory of isostasy,[8] have been made in India by the officials of the Trigonometrical Survey of India. It may be said that the work in India and that in the United States supplement and confirm each other.

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[4] G. K. Gilbert: The Strength of the Earth's Crust [Abstract], *Bull. Geol. Soc. of America*, Vol. 1, 1889, pp. 23–27.

*Idem:* Notes on the Gravity Determinations Reported by Mr. G. R. Putnam, *Bull. Philos. Soc. of Washington*, Vol. 13, 1895–99, pp. 61–75.

W J McGee: The Gulf of Mexico as a Measure of Isostasy, *Amer. Journ. of Sci.*, No. 261, Ser. 3, Vol. 44, 1892, pp. 177–192.

G. R. Putnam: Relative Determinations of Gravity with Half-Second Pendulums, and Other Pendulum Investigations, *U. S. Coast and Geodetic Survey Rept. for 1894*, Appendix I, pp. 7–50; and G. K. Gilbert: A Report on a Geologic Examination of Some Coast and Geodetic Survey Gravity Stations, *ibid.*, Appendix I, pp. 51–55.

G. R. Putnam: Results of a Transcontinental Series of Gravity Measurements, *Bull. Philos. Soc. of Washington*, Vol. 13, 1895–99, pp. 31–60.

F. L. Ransome: The Great Valley of California: A Criticism on the Theory of Isostasy, *Univ. of California Publs. in Geology*, Vol. 1, 1893–96, pp. 371–428.

Bailey Willis: The Mechanics of Appalachian Structure, *Thirteenth Ann. Rept., U. S. Geol. Survey, 1891–92, Part II, Geology*, pp. 237–281.

[5] J. F. Hayford: Figure of the Earth and Isostasy from Measurements in United States, U. S. Coast and Geodetic Survey, Washington, D. C., 1909. (No number.)

*Idem:* Supplementary Investigation in 1909 of the Figure of the Earth and Isostasy, U. S. Coast and Geodetic Survey, Washington, D. C., 1909. (No number.)

[6] J. F. Hayford: The Geodetic Evidence of Isostasy, with a Consideration of the Depth and Completeness of the Isostatic Compensation and of the Bearing of the Evidence Upon Some of the Greater Problems of Geology, *Proc. Washington Acad. of Sciences*, Vol. 8, 1906, pp. 25–40; *idem:* The Earth, a Failing Structure, *Bull. Philos. Soc. of Washington*, Vol. 15, 1907–10, pp. 57–74.

[7] J. F. Hayford and William Bowie: The Effect of Topography and Isostatic Compensation Upon the Intensity of Gravity, *U. S. Coast and Geodetic Survey Special Publ. No. 10, Geodesy*, Washington, D. C., 1912.

William Bowie: Effect of Topography and Isostatic Compensation Upon the Intensity of Gravity, *U. S. Coast and Geodetic Survey Special Publ. No. 12, Geodesy*, Washington, D. C., 1912.

*Idem:* Investigations of Gravity and Isostasy, *U. S. Coast and Geodetic Survey Special Publ. No. 40, Geodesy*, Washington, D. C., 1917.

[8] See especially S. G. Burrard: Investigations of Isostasy in Himalayan and Neighbouring Regions, *Survey of India Professional Paper No. 17*, Dehra Dun, 1918. See also papers by Colonel Burrard, "A Brief Review of the Evidence Upon Which the Theory of Isostasy Has Been Based," *Geogr. Journ.*, Vol. 56, 1920, pp. 47–59; "On the Origin of Mountain Ranges," *Geogr. Journ.*, Vol. 58, 1921, pp. 199–218; and the review by A. Mosley Davies, "The Problem of the Himalaya and the Gangetic Trough" *Geogr. Journ.*, Vol. 51, 1918, pp. 175–183.

Some general conclusions from the isostatic investigations in the United States and India are:

1. The earth's crust is in a state of practically perfect isostatic equilibrium.

2. The depth to which the isostatic compensation extends is not and cannot be correctly determined, nor is it possible to determine in what manner isostatic compensation is distributed, whether uniformly with respect to depth or in some other manner.

3. If it is assumed that the isostatic compensation is uniform with respect to depth and is complete within a certain depth, then the most probable limiting depth is about 60 miles.

4. It is impracticable or impossible to determine whether the isostatic compensation is directly under a topographic feature to the extent that single mountain peaks are compensated within the column directly under them.

5. It has been determined, however, that the isostatic compensation of a topographic feature is probably not distributed horizontally to distances as great as 100 miles from the feature.

6. The isostatic compensation of topographic features is so complete that the deflections of the vertical are only approximately 10 per cent of what they would be if the land masses were excess loads on the earth's crust. Also the isostatic condition of the earth's crust is such that the gravity anomalies, that is the differences between the observed and the computed values for the intensity of gravity, are on an average not more than 15 per cent as large at stations at high elevations, as they would be on the theory that the earth's crust is rigid.

The above conclusions are in every way justified from the exact measurements that have been carried on in the United States and, to a limited extent, in other countries; though specific attention should be directed to numbered paragraph 3 above and to the assumptions preceding the concluding estimate of limiting depth of compensation. Such assumptions can of course be made the basis of further investigations that may modify the result.

There are other conclusions which seem to be justified, and some of them will be discussed below. It should not be understood that they are the only ones that can be reached; but they seem in the present state of knowledge to be logical, and they do not conflict with the existing geodetic and geophysical data.

## The Rigidity of the Earth's Crust

The earth's crust must have considerable rigidity in order to maintain the irregular relief of the earth. It is true that each unit column of the earth's crust, or isostatic shell, as it has been very aptly called by Bailey Willis, has the same mass as any other unit column, but we must not think

in terms of columns of very small cross section. It seems safe to assume a unit cross section for compensated areas of 70 miles square, the approximate area of a square degree at the equator.

What the geodetic observations and investigations have done is really to measure indirectly the differences in weight of the masses in the various unit columns of the earth's crust, and these columns have been found to be remarkably near each other in the amount of their masses.

If the earth's crust were not rigid to a certain extent, mountain masses would overflow marginal areas of lower elevation; likewise, the material of a continent would overflow the ocean bottom. If there were no rigidity in the earth's crust, this process would continue until all irregularities in

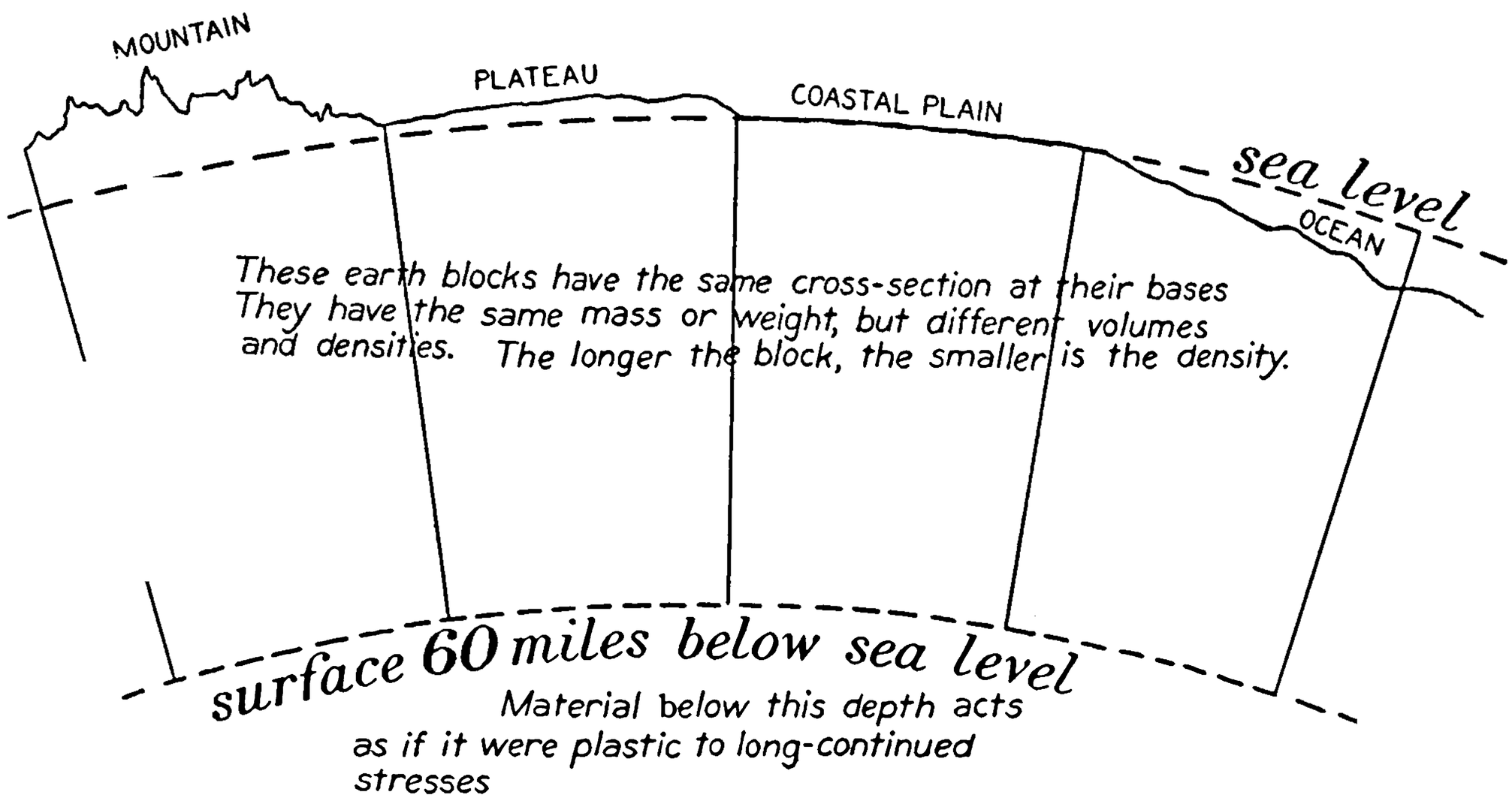
MOUNTAIN
PLATEAU
COASTAL PLAIN
sea level
OCEAN
These earth blocks have the same cross-section at their bases
They have the same mass or weight, but different volumes
and densities. The longer the block, the smaller is the density.
surface 60 miles below sea level
Material below this depth acts
as if it were plastic to long-continued
stresses

FIG. 1—Probable limiting depth of isostatic compensation.

the surface of the earth were smoothed out. There is in reality a tendency toward overflow, just as there is a tendency for any structure to collapse, but the rigidity (combined with the strength) of the material keeps it in place. Apparently the rigidity of the earth is such that this flattening out will never occur. However, the resistance of the earth's crust, while great enough in a horizontal direction to resist the flattening of the earth's surface, is not great enough to withstand the vertical stresses developed by the erosion of matter from high ground and its deposition in low areas.

Enormous loads of material are taken from mountain areas and deposited in valleys or at the mouths of rivers. If the earth's crust were of such rigidity and offered such resistance to vertical forces as to hold up the sedimentary material, this fact would be easily discovered from the geodetic data on the deflections of the vertical and the intensity of gravity. This question has been very carefully considered, and it has been found that areas of sedimentation are as nearly in a state of perfect isostatic equilibrium as more quiescent areas, geologically speaking.

As another evidence of the inability of the earth's crust to withstand a vertical stress we may cite the case of a mountain mass from which thousands

of feet of material have been eroded in recent geologic times. If the mountain were in isostatic equilibrium before the erosion began, then it certainly would not be in equilibrium at the present time if no upward movement had occurred at the base of the mountain column to offset the loss of material by erosion at the top. The mountain mass is *now* in equilibrium, and therefore as erosion progressed there must have been *in the past* a transfer of material to the column under it.

We may accept the fact that areas of sedimentation and areas of erosion are in substantial equilibrium not only in the United States but in other countries. Wherever isostatic investigations have been made the data confirm this conclusion.

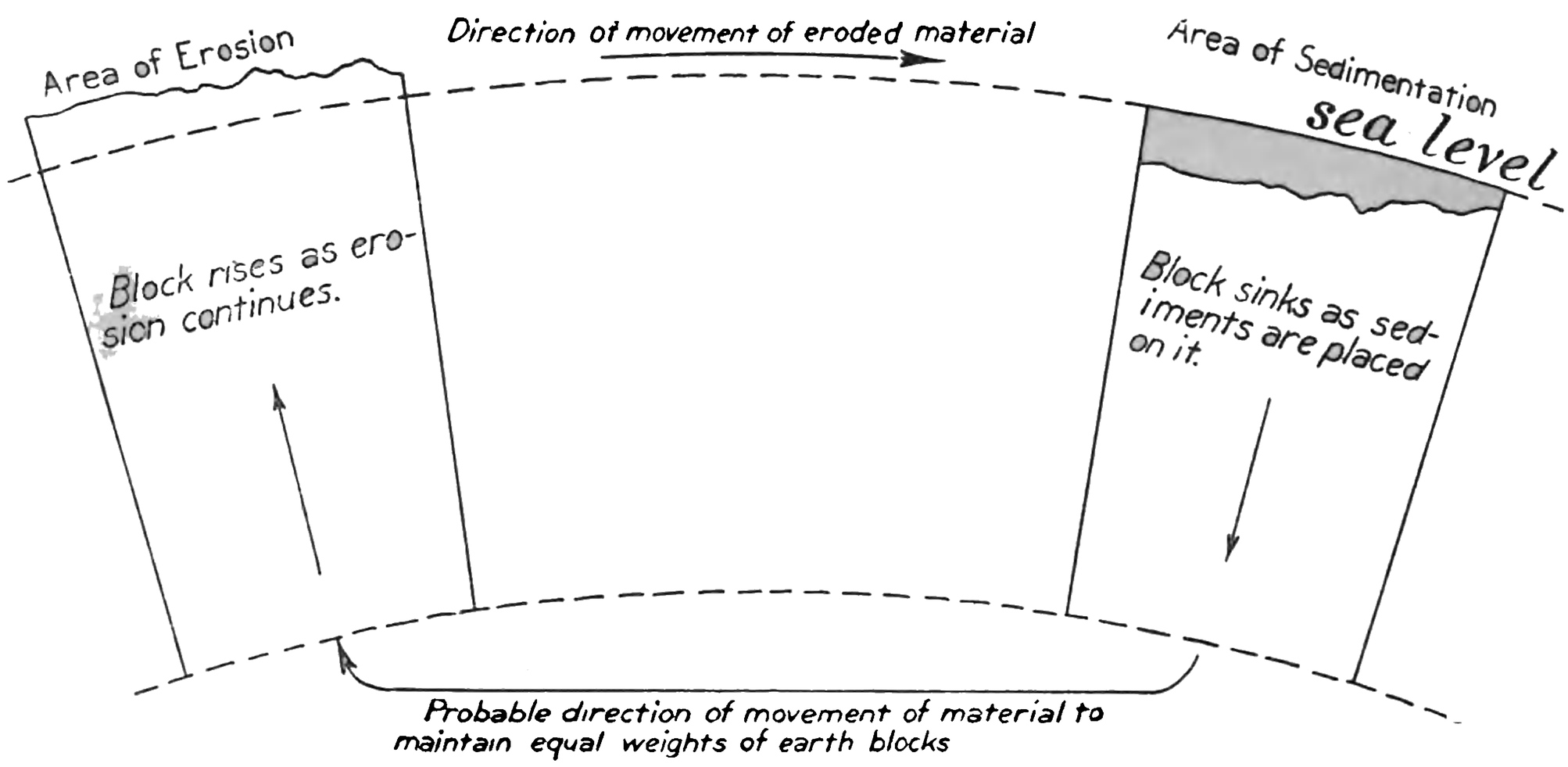
Area of Erosion
Direction of movement of eroded material
Area of Sedimentation
sea level
Block rises as erosion continues.
Block sinks as sediments are placed on it.
Probable direction of movement of material to maintain equal weights of earth blocks

FIG. 2—The mode of compensation between a rising column in an area of erosion and a sinking column in an area of sedimentation.

## ZONE OF FLOW

As the earth's crust is in isostatic equilibrium we must conclude that there is a transference of material horizontally from areas of sedimentation to areas of erosion. It is only in this way that the isostatic balance can be maintained. Assuming that horizontal movements maintain that balance, we are forced to conclude that the material at some point below the crust of the earth is of a yielding nature, much more so in fact than any matter near the surface of which we have knowledge.

Seismologic observations and those connected with the determination of earth tides, prove conclusively that the earth's material at all depths is solid. The response of the solid crust to the tide-producing forces of the sun and moon is only a fraction of what it would be if the earth were thoroughly plastic. The seismic waves that travel to a distant observer from an active earthquake center pass by a direct route through the earth, and this would not be the case if the crustal matter were liquid or if it were plastic to short-time stresses.

We have apparently to conclude that there is a zone below the isostatic shell, or the crust of the earth, within which the matter is rigid to stresses

continued over a short period, such as the tide-producing forces of the sun and the moon, but is plastic to the long-continued stresses which result from an unloading of one part of the isostatic shell and the loading of another. When we speak of long-continued stresses we have in mind stresses that last for thousands of years, that is, we are speaking in geologic time rather than in human time.

The condition of the material of the earth below the zone of flow need not be considered for our present purposes. When we speak of a zone of flow we are simply trying to visualize the condition of affairs below the earth's crust involved in the transference of material to maintain the isostatic balance, and we do not necessarily imply that this zone has limited thickness. It may be a thin zone, a thick zone, or one that extends throughout what may be called the nucleus of the earth, the nucleus being that portion of the earth below the isostatic shell.

It seems logical to assume that the flow of material, due to transference of material at the surface of the earth, must be at or below the base of the isostatic shell. In the first place the determination of the depth of the isostatic shell, or that depth within which the isostatic compensation exists, presupposes that the material above that depth is somewhat different in its behavior from the material below. If there were a transference of material within the isostatic shell, then it is rather difficult to see how there could be an isostatic compensation occurring within this moving material. If the isostatic compensation were in material that is plastic enough to move horizontally, then surely this plastic material would assume a condition of hydrostatic equilibrium within a very short time, geologically speaking. The material could not be like the outer portion of the earth, which is able to withstand the tendency of gravity to flatten out the irregularities of the surface.

The second objection to having the isostatic adjustment of flow take place above the depth of compensation is that there is an equality of pressure at the depth of compensation. At that depth columns of like cross section balance each other in pressure or weight. Now, when there is a transference of material from one column to another at the surface and the corresponding isostatic flow begins, we certainly have to go practically to the depth of compensation in order to find the hydrostatic pressure to make the material flow from the short column—the one subjected to sedimentation—to the mountain column from which the sediments have been eroded.

If we assume an isostatic flow only a few miles below the surface, should we not be trying to move material from a light block to a heavy one? In a plane of reference, say 10 miles below sea level, we might have the base of a column 11 or 12 miles in length under the area of erosion (mountains) and one of only 10 miles in length under the area of sedimentation (plains). It is evident that at a depth of 10 miles the stress difference will be from the mountain area towards the plains area. Only when erosion on the one

hand and sedimentation on the other have been so great as to cause the plains section of the crust to overbalance the weight of the mountainous crust could we expect to have flow from the plains area to the mountain area. The flow resulting would take place at whatever depth the pressure is greater under the sediments than under the mountains from which the material was eroded.[9] What is the depth at which this pressure difference is expressed in flow? Let us turn to this as the next item of enquiry. It is easy to compute at what depth the weight of a column on which the sediments have been placed will equal that of the column under the area that has been eroded if the compensation is assumed to be uniformly distributed

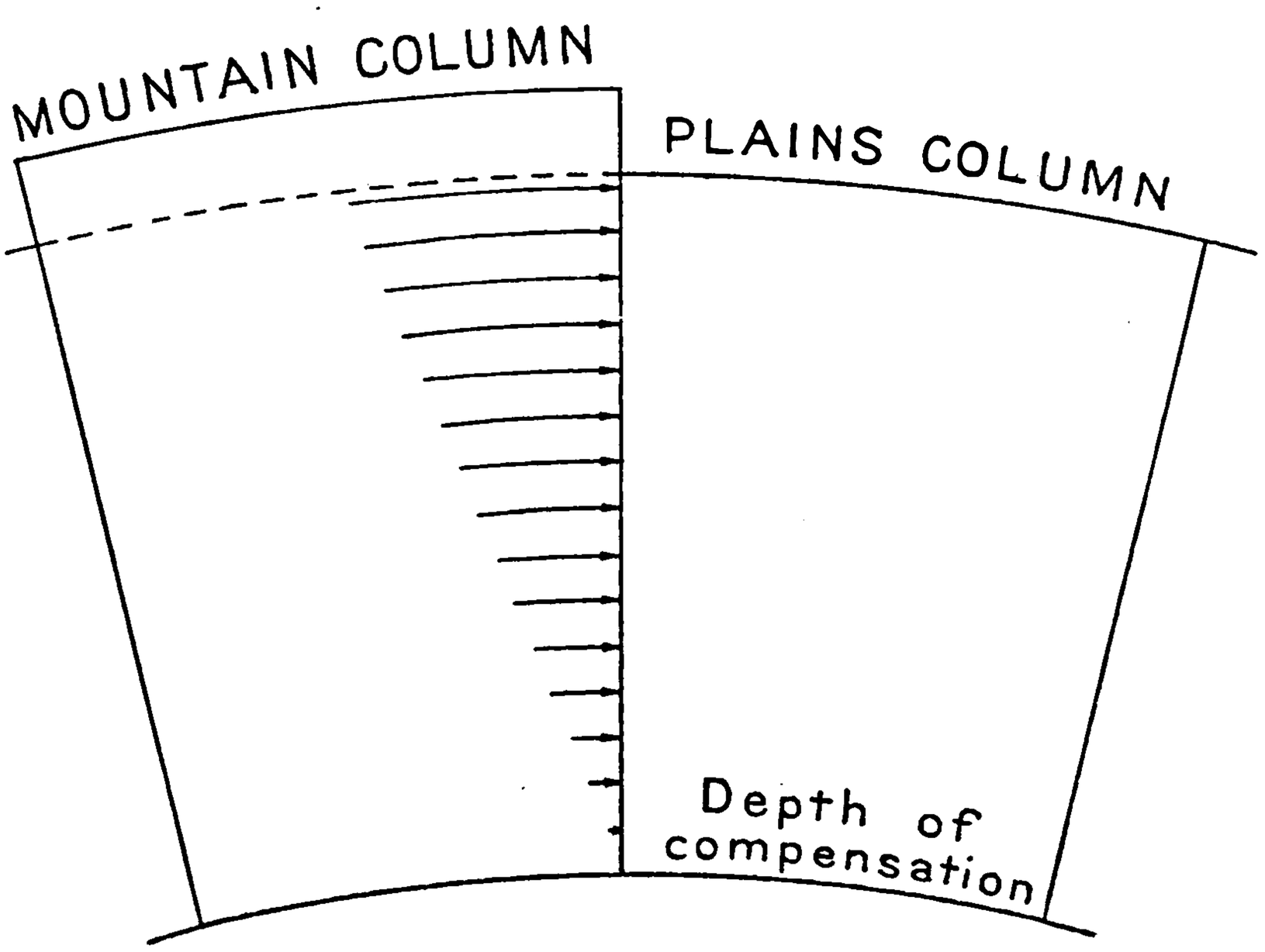


FIG. 3—Depth of compensation between mountain and plains columns when transference of material from one to the other, at the surface, is just beginning.

with regard to depth. The greater the transference of matter before isostatic adjustment has begun,[10] the nearer the surface will be the depth at which the pressures of the columns will be equal. It seems reasonable to assume that the amount of material which can be deposited before isostatic adjustment begins is quite small, less than 1,000 feet in thickness. Therefore, if we hold to the view that 1,000 feet of material over a rather extended area is the maximum that will escape isostatic compensation, then we shall find that the depth at which the flow must take place is greater than 50 miles.

This question of the depth at which the isostatic adjustment takes place is a most important one from a physiographic standpoint. If the flow occurs as a deep-seated phenomenon, we must conclude that the configuration of the earth's surface between the area of erosion and the area of sedimenta-

[9] This idea is brought out by Hayford in his article entitled, "The Relations of Isostasy to Geodesy, Geophysics and Geology," *Science*, Vol. 33 (N. S.), 1911, pp. 199–208.

[10] Undoubtedly the isostatic adjustment lags somewhat behind the transference of matter at the surface.

tion has little or no relation to the material moving horizontally at or below the lower surface of the crust. It is not probable that any wavelike distortion of an extensive character can be due to this slow movement of the plastic materials below the isostatic shell. If the flow were close to the earth's surface, say within a few miles, then undoubtedly there would be an effect on the configuration of the earth's surface by the horizontal movement, just as the flow of molten lava will greatly distort the cooler solid lava which floats on it.

It is probable that in an alluvial plain there is at least some horizontal movement of material near the surface, possibly within a mile, due to stress

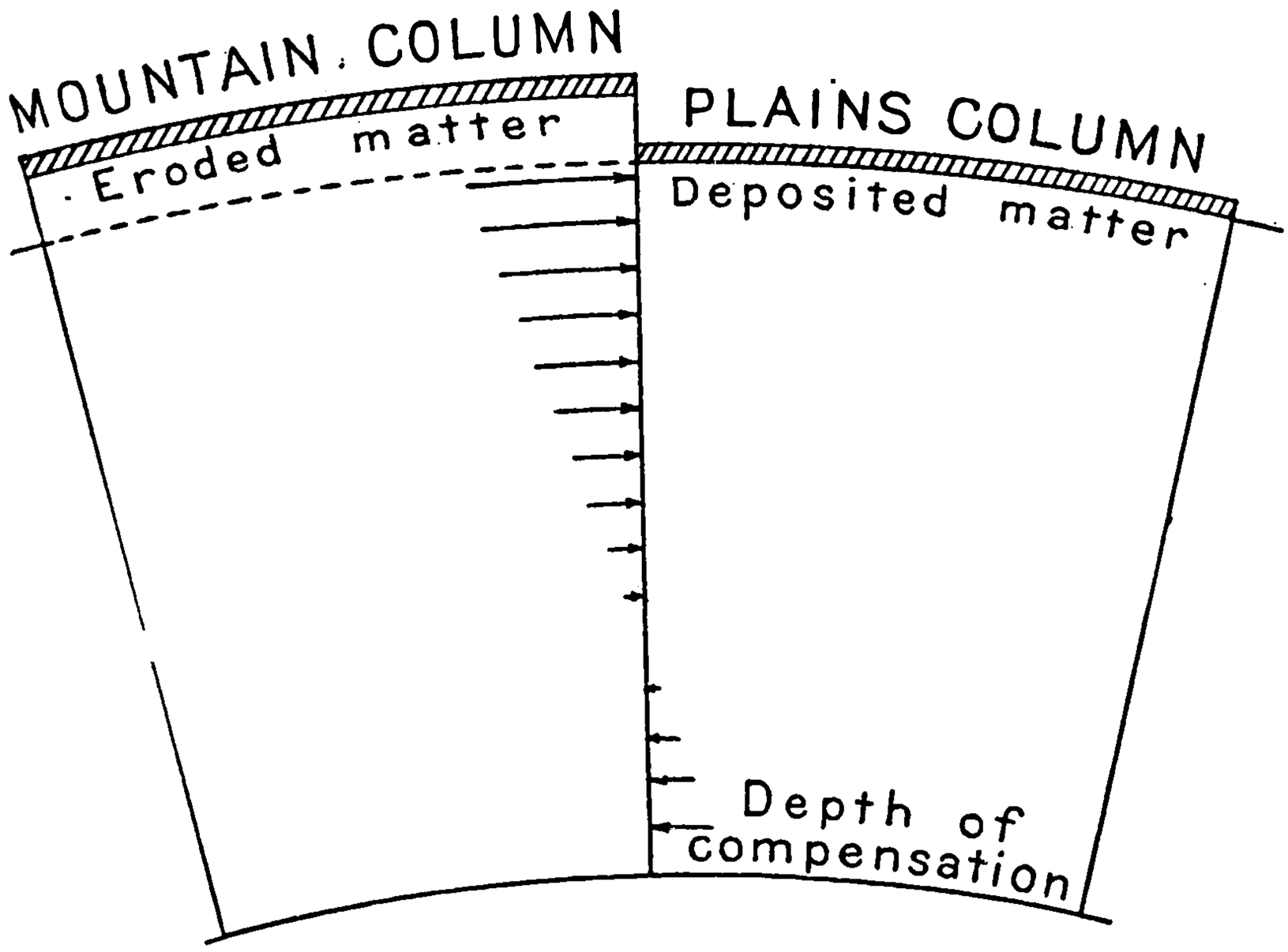


FIG. 4—Depth of compensation between mountain and plains columns after the transference of eroded material at the surface has continued without compensation by deep-seated flow. This depth is taken to exceed 50 miles for a surface accumulation of eroded material 1,000 feet thick.

differences in the unconsolidated sediments. But we should expect no movement from one block toward another of greater mass.

It is certain that there cannot be a flow of material near the surface from a narrow mountain valley back toward an adjacent mountain slope from which material is being eroded and deposited in the valley. The stress difference in the upper portion of the isostatic shell is always from the mountain toward the adjoining valley. It is very improbable that columns of small cross section are individually in isostatic equilibrium and that a small valley column could sink throughout its entire length and uplift a second small column under the adjacent mountain side. The rigidity of the material of the isostatic shell would certainly prevent such movements. The recently published views of Tandy on this subject appear to me to be in opposition to the plainest facts of physiography and geodesy.[11]

[11] E. A. Tandy: The Circulation of the Earth's Crust, *Geogr. Journ.*, Vol. 57, 1921, pp. 354–376.

## Mountain Systems and Oceans Not Maintained by Rigidity of Earth's Crust

Modern investigations in isostasy lead to the definite conclusion that differences of elevation between mountain masses and continents on the one hand and plains and oceans on the other are not due to the strength of the earth's crust, but that they express the deficiency of matter under the elevated areas and the excess of mass under the depressed ones.

It should be clearly borne in mind that the continents compensate the deficiency of density under them and that the oceans compensate the excess of density below their bottoms. In other words, the land masses and the oceans are the effect of the abnormal densities rather than the cause.

If the mountain mass is not an extra load, neither is it due to regional horizontal pressure and movement. We conclude that it is due to vertical forces and movements and that an expansion of the matter under the mountain area is the most probable cause of the uplift.

The question immediately arises, what is the cause of the expansion? This is a matter that is decidedly speculative or theoretical. In two recent articles[12] I have suggested that the cause of the expansion of the material of a column under a mountain system may be due to a heating of material forming this column when it was beneath an area of sedimentation and sinking into hotter regions.

As sediments are deposited, an extra weight is added at the plane of compensation. It is probable that the sediments are so small in mass in some places that no vertical movement takes place; but we know that in other places enormous amounts of sediments have formed, as indicated by the exposed strata in mountainous regions. Nearly all mountain areas were at one time areas of heavy sedimentation, and the sediments were deposited in shallow water or not much above sea level. This process of heavy sedimentation is now going on at the mouth of the Congo, in the Indo-Gangetic region, and about the La Plata estuary.

The sediments from which mountains were formed were in some cases 30,000 feet or more in thickness. Let us assume that in some particular case this depth of sediments was six miles. As the sediments were deposited, the matter in the crust under them was forced down into regions that were hotter; and, when the base on which the sediments had been placed was depressed to the extent of six miles, every portion of the column from the base of the sediments to the depth of compensation was subjected to a temperature that was hotter by the change in temperature for a difference in depth of six miles. This change in temperature is not known; but, if the temperature gradient is anywhere near what it is for the first mile of the earth's crust, the change is very great.

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[12] William Bowie: The Relation of Isostasy to Uplift and Subsidence, *Amer. Journ. of Sci.*, Ser. 5, Vol. 2, 1921, pp. 1–20.

*Idem:* Some Geologic Conclusions from Geodetic Data, *Proc. Natl. Acad. of Sci.*, Vol. 7, 1921, pp. 23–28.

It is probable that a surface of equal temperature, termed "geoisotherm," will be somewhat depressed as the sediments are being placed on the surface and the column is sinking. Later the geoisotherm will rise to its normal position. In this process the material under the sedimentary area will become much hotter than it was before sedimentation began, and it is my view that physical or chemical changes or both will occur which will expand the material of the column and thus elevate the surface to form a mountain system.

This vertical movement of material would undoubtedly be accompanied by the development of inclined forces, and in some cases even horizontal ones, which would move the material in such directions as to cause the distortions that may be observed in an uplifted area. The base of a moun-

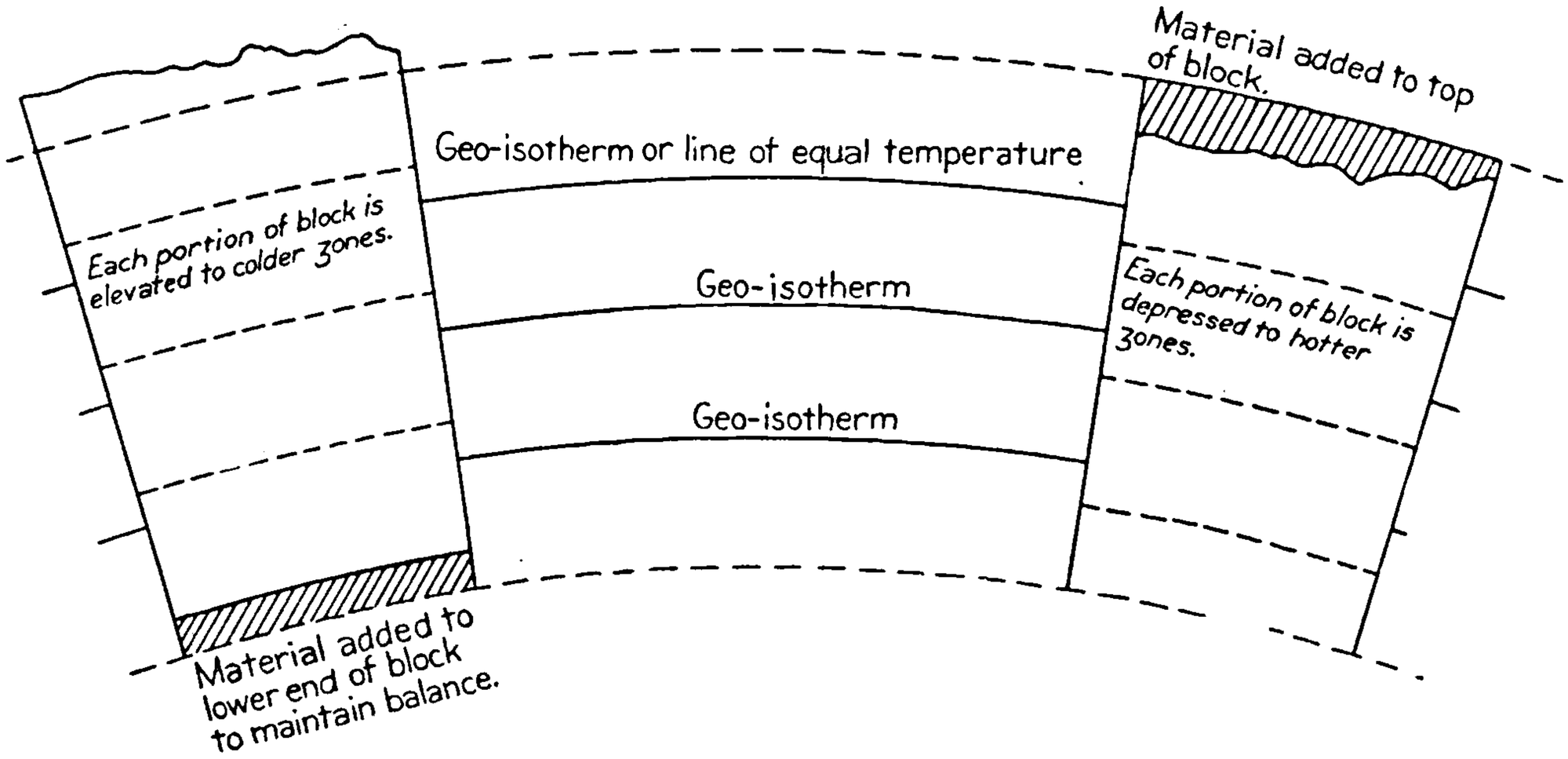
Material added to top of block.
Geo-isotherm or line of equal temperature
Each portion of block is elevated to colder zones.
Geo-isotherm
Each portion of block is depressed to hotter zones.
Geo-isotherm
Material added to lower end of block to maintain balance.

FIG. 5—Changes of temperature in rising and sinking columns to suggest the deforming effect of expansion in a sinking mass under an area of sedimentation.

tain system is usually quite large, the Appalachian system being considered as approximately 200 miles in width by 1,000 or more miles in length. This is an area quite large enough for the development of horizontal and inclined forces due to the uplift of material in response to changes in density.

It is undoubtedly true that sediments are deposited in a very irregular way. Some part of a region of sedimentation that eventually will become the location of a mountain system will naturally receive most of the sediments, but as sedimentation progresses the surface of this area may become higher, by the building-up process, than contiguous areas. When this has occurred sedimentation is then shifted to one of the lower areas, and so on throughout the history of the region. Since sedimentation takes place in different parts of the area at different times and at different rates, we should expect a large amount of distortion of the sedimentary strata during the process of subsidence under the added loads.

After sedimentation has ceased in a given region and possibly after a long period of quiescence an upward movement may occur resulting in the formation of a mountain system. During the uplift there is probably a very irregular movement due to variations in the resistance of the recently

deposited sedimentary matter and of the material of the crust below it. The different resistances would, presumably, permit the uplift to occur more rapidly in one part of the region than in another. When the uplift in one area had progressed to a point where resistance to further uplift on account of the weight of the uplifted material was greater than in an area in which uplift had been retarded, vertical movement would probably take place in the latter area.

There would be a great force acting to restrain uplift near the edges of a rising column, for it is probable that the uplift would be confined largely to the column on which sedimentary material had been placed. Probably the greatest distortion of strata would occur near the edges of the area of uplift. Thus, much of the distortion of strata which in the past has been attributed to the horizontal thrust of forces originating in the areas outside the mountain areas may be due to the different rates of subsidence and uplift in the region now occupied by a mountain system which was formerly an area of sedimentation.

## Isostatic Adjustment Tends to Maintain Mountain Systems

It is possible to compute the rate of erosion over a large area, especially where careful analysis of the waters of the rivers draining the area in question has been made. This rate of erosion will vary in different parts of a continent and in different parts of the world; but it is a function of the amount of rainfall, the steepness of the slopes, the composition of the surface materials, the character of the vegetation covering, and possibly other conditions. It can be safely said that the flattening process is a very slow one and, even if there were no further uplifts due to expansions of columns of the isostatic shell, the time necessary to wear down a mountain system would be very great, and mountains on the continents would remain for a long time. But it is also very probable that the expansion of columns under areas heavily sedimented will continue in the future and form new mountain systems.

Geodetic researches indicate very clearly that mountain columns must have been maintained in isostatic equilibrium throughout the erosional period. It might be thought that when 100 feet of material has been eroded from a mountain area the mountain would be raised vertically by the same amount to maintain equilibrium. But the material that is brought into the column under the mountain area by isostatic adjustment is undoubtedly denser than the material eroded from the surface, and, therefore, not so great a volume is needed to maintain the isostatic balance. It is probable that the difference in density of the surface material and that at a depth of about 60 miles is as much as 10 per cent. When 100 feet on an average is eroded from an area, the disk of material brought into the column at its base is, on this assumption, only 90 feet in thickness, the difference in thickness of the two disks being due to the difference in density of 10 per cent.

Therefore, on the assumption that compensation at the isostatic level is taking place without delay, as an area is eroded 100 feet we should expect its average elevation to be 10 feet lower than before the erosion began. Similarly, if 1,000 feet of material is eroded, the average elevation should be reduced by 100 feet; and if 10,000 feet is eroded, the average elevation should be reduced 1,000 feet; and so on.

The process of gradually decreasing the average elevation of an area accounts for the presence of sedimentary material tens of thousands of feet in thickness which must have been eroded from mountain systems of moderate horizontal dimensions. We can see that to reduce to sea level a mountain system of an average elevation of 5,000 feet, approximately 50,000 feet must be eroded from its area.

This continued uplift of the material of a mountain during erosion probably accounts for the exposure of an igneous core. From the Rocky Mountain area there have been eroded many thousands of feet, and in places the sedimentary material has been entirely removed. This also has occurred in a number of places in the Alps, where the highest peaks are formed of abyssal igneous rocks. Without the great amount of erosion that is involved in wearing down a mountain system the originally deep-seated igneous rocks could not have been uncovered.

Does it not seem possible that, as the uplift of the mountain continues after the system has once been elevated, there should be a tremendous amount of distortion of strata due to the isostatic adjustment? I think this vertical movement accounts for much (though not all) of the rupture and distortion of the strata which in the past has been considered as the result of regional forces of different origin acting horizontally in the earth's crust.

The mountains will certainly be gradually, although very slowly, base-leveled as the results of erosion, in spite of the tendency towards approximate maintenance at the original elevation by isostatic adjustment. The differential density between the eroded material and the material brought into the base of the column in response to isostatic adjustment will eventually leave a mountain system at a low altitude. This will occur, however, only after tens of thousands of feet of material have been eroded from the area, an amount wholly disproportional to the original elevation of the mountains.

## Possible Cause of Subsidence

When a mountain area has been lowered 5,000 feet and base-leveled, all parts of the original column under the mountain area have been brought possibly from 8 to 10 miles closer to the surface of the earth than they were before erosion began. After the erosion period of a particular area is ended, then it would be expected that the material in the column, which had been brought up into colder regions, would lose some of its heat and that chemical or physical changes might occur that would tend to contract it. It is prob-

able that the geoisotherms, or surfaces of equal temperature, were bent upwards in the upward movement incident to the isostatic adjustment of the column and that these geoisotherms are gradually depressed to their normal depths after the active erosion of the surface of the column has ceased. As this cooling process goes on in the column under the former mountain area it is possible that the surface of the earth may be depressed to sea level or even below it. When this has occurred, then the area may again become one of sedimentation; and the process of depositing the sediments that may eventually be thrown up as a mountain system is started over again. It may be that mountain areas have been what may be called active regions for geological ages past and that there has been a succession of sedimentation, mountain uplift, base-leveling, repeated sedimentation, a second uplift, and so on. It is possible also that there are areas in which heavy sedimentation has never occurred and which have never been elevated into a mountain system or a high plateau.

## Outstanding Problems

A number of problems will have to be solved before we know very much about the causes of the uplift of continents above the ocean level and the processes that are involved in the uplift of an area that was once at low altitude. For example we should like to know what caused the first irregularities in the surface of the earth. There must have been some areas higher than others in order that there could be initial erosion and transportation of material.

It is possible that there was an initial difference in the density of the material in different parts of the earth's crust causing large differences in elevation. It may be that the average elevation of the areas comprising the present continents has always been greater than the average elevation of the areas now occupied by oceans. This does not mean, however, that there have not been decided changes in the elevation of parts of the continents. At times parts of the continents have been under water and at other times many thousands of feet above sea level, forming mountain masses. Changes are continually taking place in the density of the materials in the isostatic shell which cause considerable changes in the elevations of affected areas. Large changes may have occurred in the elevation of the bottom of the oceans. In places mountains may have been formed reaching to the surface, and at other places there may have been a sinking of the bottom. Such changes must be the result of changes in density and must be due to changes in volume rather than in chemical composition. Dr. Henry S. Washington has been working on the matter of the relation of the general elevation of an area to the chemical density of its igneous rocks. He has found that the average density of these rocks occurring on continents is less than that of igneous rocks occurring on oceanic islands. It appears from his work that the chemical density of the material in the crust under the oceans is greater than that under the continents.

To point to another problem, it is of the greatest importance that an apparatus be perfected which will permit the accurate determination of gravity at sea. Much work could be done with such an apparatus at small expense, and the results would show very definitely whether the earth's crust under ocean areas is in the same state of equilibrium as under the land. In my opinion such observations will prove that isostatic adjustment is world-wide. The geodetic institutions of the countries of the world should carry on isostatic researches, using the accumulated data in the form of deflections of the vertical and the intensity of gravity which they now have at their disposal. Gravity observations should be made in many land areas of the earth which have not yet been explored so far as gravimetric surveys are concerned.

Much remains to be done, but the isostatic investigations of the past twenty years have shown that the earth's crust is in a state of equilibrium. This work has been done by the geodesist, and we must now look largely to the geologist to apply the knowledge gained by the isostatic investigations to the interpretation of the forces and movements which have brought about and maintained the isostatic equilibrium.

# CONCERNING AERIAL PHOTOGRAPHIC MAPPING: A REVIEW *

By James W. Bagley

To the geographer, to the explorer, and to the pioneer interested in learning the character and resources of remote parts of the world the possibility of mapping before penetrating is like the short way to India and Cathay.

## Mapping of Inaccessible Country

The application of this possibility in Morocco, where the French have the task of establishing order in a large area of country which is inhospitable both because of its character and the unfriendliness of the tribes, is discussed by Colonel Noirel. The method here employed for mapping is to establish points of control on the terrain occupied and to mark them with signals which can be identified on aerial photographs. Flying at great height directly over the marked points, two series of photographs are taken, one with a camera pointed downward and a second with a camera pointed obliquely toward the mountains. Though Colonel Noirel does not so state, it is supposed that the two cameras are joined rigidly together and that the relationship between the two chambers is carefully determined. The effect of this arrangement would be that the aerial positions and orientations of the photographs could be obtained from the "vertical" [1] photographs which embrace the targets, and afterwards directions and vertical angles taken from the oblique photographs would supply data to map the mountains. Topographic reconnaissance maps of the scale 1:200,000 which were made in this fashion of country south of Taza have been used.

The method used by the French is undoubtedly feasible for mapping a narrow belt of absolutely inaccessible country of high mountains, but it is doubtful whether it will permit of extension over large areas of considerable

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* H. Noirel: La topographie moderne et les applications de la photographie aux levés topographiques. Maps, diagrs., ills. *Bull. Bimestriel de la Soc. de Topographie de France*, Vol. 45, 1921, pp. 106–127. Paris.

C. G. Lewis and H. G. Salmond: Experiments in Aeroplane Photo Surveying. 53 pp.; diagrs. *Survey of India Professional Paper No. 19.* Dehra Dun, 1920. 3 s. 11 x 8½ inches.

M. N. Macleod, comp.: Mapping from Air Photographs. 66 pp.; maps, diagrs., ills., index. General Staff. War Office, London, 1920. 4 s. 13 x 8½ inches.

H. Roussilhe: Applications de la photographie aérienne aux levés topographiques de précision. Diagrs. *Annales Hydrogr.*, No. 703, Ser. 3, Vol. 1, 1917, pp. 81–176. Paris.

—— Rapport sur les études techniques effectuées in 1919 et 1920 sous la direction de M. H. Roussilhe. Reconstitution Foncière et Cadastre, Ministère des Régions Libérées, Paris, 1921.

—— The Use of Aerial Photographs in Topographic Mapping. 31 pp.; maps, diagrs., ills. *Air Service Information Circular No. 184*, Washington, D. C., 1921.

[1] During the World War it became customary in the armies of the United States and Britain to speak of aerial photographs which had been taken with the optical axis of the camera directed downward as "verticals." The French usually keep in mind the position of the negative in the camera and call them horizontal photographs.

depths such as the topographer maps at comparatively small scale on a reconnaissance trip of three months with pack train in much of our western mountainous country. Locations thus made of points in the reaches adjacent to the marked control points might be accurate enough to serve as control for another similar set of photographs, but it is improbable that locations made from a second or third set of photographs would afford sufficiently reliable control to continue by such an overlapping process the mapping of a deep zone.

Colonel Noirel also speaks of the attractive work which the topographer has in northern Africa where he interests himself in Roman archeology as found in buried cities, in botany, the relation of flora to soil, entomology, geology, etc. His picture is alluring.

## Use in Hydrographic Charting

During the last year the Service Géographique has prepared planimetric maps in France at the scale 1:10,000 from aerial photographs but will add the contours by ground work. Progress has also been made in hydrographic charting by the use of aerial photography in conjunction with a procedure of making locations by sounds. When out of sight of the shore, positions of rocks or other obstructions to navigation have been accurately determined by the time required for the detonation of a bomb exploded under water to travel to three or more shore stations where equipment for registering the disturbance is emplaced. It is stated that the British have located the positions of vessels sunk at the Battle of Jutland as distant as 200 miles from a shore station by this method. When there is only one station on shore available, radio-direction apparatus has been employed in combination with bombs, the intervals of time required for the disturbance to travel by air and by water being used to determine distances. Rocks at depths as great as 40 meters have been photographed in calm clear water.

## Experiments in Aerial Surveying in India

Major Lewis and Captain Salmond have given a faithful record in their "Experiments in Aeroplane Photo Surveying" carried out at Agra in India. The object of the experiments was to determine whether plane maps of two different classes, one at a scale of a mile to the inch, the other at a very large scale of a city, could be made by means of aerial photographs as cheaply and as satisfactorily as by the current ground methods.

The report is divided into two parts; the first by Major Lewis, the second by Captain Salmond. Major Lewis is rather emphatic in stating that "It would appear then that there is nothing to be gained by adopting the air method for normal one inch surveys in the plains of India." Captain Salmond concurs with a statement to the same effect. Concerning large-scale city surveys, definite conclusion is not reached as to the value of the method

tried; but the suggestion is made that further experimentation should be carried out.

An estimate, based on the experiment, of the cost of further inch-to-mile surveys by aerial photography gives a rate nearly twice that for surveys made during the three years 1914–1917 by the ground method. The average cost by the ground method is given as 9.1 rupees (about three dollars) per square mile. This is a low cost for plane surveys at the inch-to-mile scale. The explanation seems to be that the amount of data to be obtained for the map is small, the country is easy to travel through, and the native personnel can be employed at modest wages. From the standpoint of economics the test was a severe one for aerial photographic surveying. The conclusion reached may be the final one for work in India, but there was much room for improvement in the instruments used and the manner of carrying out the work.

An area of about five hundred square miles near Agra was selected for the small-scale survey. It consisted of two adjacent fifteen-minute quadrangles in plains country. The air force employed was four airplanes with customary personnel. These were loaned for the experiment with the understanding that they could be kept but a few days and might be recalled at any time. The holding in leash of the air contingent apparently led to an undue hurrying of the photographic work with consequent confusion and an ultimate prolongation of the time required to secure the photographs, and in the end the area had not been completely covered.

The photographic equipment was of an old type such as has for a long time in this country been considered obsolete. It appears that they lacked accessory aircraft instruments to fly courses and to regulate exposure intervals. Captain Salmond, who discusses at some length the aircraft equipment used as compared with that desired, states "that for future work of this kind, *either* machines, instruments, ground control, etc., must be so improved as to eliminate the personal factor in pilots and observers, and so obtain uniform results of a high standard of perfection *or* all pilots and observers employed must have specialized in this class of work, which differs very considerably from active service work." Automatic cameras are now in use, and means have been provided to regulate them; but the getting of useful photographs still depends on a skillful pilot and a trained observer. There seems to be no way to escape the necessity of giving competent men adequate training if success is to be reached in making maps from aerial photographs. In the Information Circular put out by the U. S. Army Air Service considered below, two examples of employing aerial photographs to prepare plane maps at the scale 1:62,500 are given. Each of these maps comprised the area of a fifteen-minute quadrangle. In both instances the work was successful from all standpoints.

## A Treatise on Aerial Mapping

In "Mapping from Air Photographs" Colonel Macleod has prepared a valuable treatise. It is evident that he has drawn freely upon the informa-

tion and experience which he gained while in France during the war. Making allowances for new data which have been gathered from experimentation since the date of the publication, the field of the subject has been fairly well covered.

Colonel Macleod gives consideration to many methods or schemes for making use of aerial photographs in mapping rather than confining his endeavor to the presentation of a particular method. Methods of correction for distortion arising from tilt of the camera, such as were employed extensively by the several armies during the World War, receive a chapter of more than twenty pages. This includes an elaborate discussion of the use and mechanism of types of the camera lucida. Part II, which takes up about half of the quarto, consists of "Proofs of Geometrical and Other Theorems Relating to the Plotting and Rectification of Air Photos." Some general principles of perspective figures and special applications of the principles to instruments are given.

In a chapter headed "The Framework" it is made plain that an elaborate net of control points is considered indispensable for accurate mapping with aerial photographs. It is assumed that the control points must be established wholly by ground work. Mapping at what in the United States are considered large scales is in mind. In the United States and in all new countries the great need is for maps at moderate scales (one inch to the mile up to three inches to the mile), and control has to be established as the maps are made. It is therefore of great importance, when considering means and methods of operation, whether the cost of a large number of control points has to be borne or whether it is possible to get along with a fewer number. The feasibility of applying aerial photographs to surveys depends to a large extent on the amount of supplementary ground work required to make them useful. A method of aerial photography cannot be successful for our moderate-scale surveys unless it can be applied with comparatively few points of control which can be readily and inexpensively established.

## Photo Restitution

In contrast to Colonel Macleod's compilation, H. Roussilhe has given a study of a particular method of using aerial photographs in connection with accurate mapping. His primary purpose was to discuss the principles of photo restitution[2] as applied to apparatus he devised. As Director of a division (Reconstitution Foncière et Cadastre) of the Ministère des Régions Libérées, he is concerned with restoring properties in the devastated parts of France to their owners, and in order to make the surveys needed to do this expeditiously he turned to aerial photography as a possible aid. The nature of this task required that the results be accurate enough for surveys of the

[2] The word "restitution" has been employed by the French in connection with aerial photographs for ten years or more. It was adopted by the English-speaking forces during the World War and, as used by them, is equivalent to plotting data from aerial photographs. As employed by the French it means the treatment of a photograph through all of the steps necessary to produce a plan or a map of the objects it pictures.

cadastral class. He worked to make his apparatus and method meet that standard. At the date of publication the opportunity had not been afforded him to verify the accuracy of results by a field demonstration, but it is understood that triangulation had been started to make a test survey at the scale 1:2,000.

A large part of the study is given to a discussion of the principles and general conditions of photographic restitution, the characteristics and description of photo-restitution apparatus, and the method of employing the apparatus which was devised by himself. Relationships to be maintained between factors of the aerial camera and those of the restitution apparatus to simplify and facilitate the mapping work are established, and graphs and tables are supplied to provide for ranges in altitudes of flights and inclinations of the camera.

A chapter is devoted to the method to be followed for making surveys with aerial photographs, and, taking 1:2,000 as the scale to be employed, details of the several phases of the work are sketched. The permissible error for positions of triangulation stations is stated as but two-tenths of a meter. Points of the great triangulation net in France of the first order of accuracy are accepted as meeting this requirement, but points of the second and third order do not as a rule meet the requirement and therefore can be used only with caution. At least three points of control are required for each photograph. Levels must also be established with an accuracy commensurate with that desired for the positions of control points. It is considered sufficient to have the elevations of only the control points, for it is expected that all other required vertical data can be obtained from the photographs. It is proposed to take both vertical and oblique photographs in series such that there shall be four photographs covering every part of the terrain. Any point to be located can therefore be intersected by a line from each of at least three photographs. The oblique photographs will be taken with the optical axis of the camera inclined about 30° from the vertical. The elevation chosen for flights is 2,000 meters above the terrain. The cameras being equipped with 50-centimeter lenses, the approximate scale of the photographs will be 1:4,000. It is intended to select enough negatives from the lot thus obtained to make two sets of restitutions, and one set is to be employed to check the results of the other set.

The need for a high order of accuracy in the control scheme is emphasized. This presages a high order of accuracy in making locations of random points and in determining their elevations. Estimates of the refinement possible in the results are given in a chapter headed "Accuracy of Results." Here it is stated that if negatives of the approximate scale of 1:4,000 are used to construct a map of the scale of 1:2,000, the relief of the terrain covered by any negative being not more than plus or minus 40 meters (with reference to control points), errors of location made will not exceed two-tenths of a meter, and errors of elevations determined will not exceed half a meter. Cadastral surveys will require exceedingly careful work, but

topographic mapping at scales commonly used does not require so high a degree of refinement in results. For work at the scale 1: 10,000 it is stated that all except mountainous country could be satisfactorily surveyed by the method.

Major Roussilhe very properly refers to Colonel Laussedat [3] as the father of photogrammetry and gives credit to Captain (later Lieut.-Colonel) Saconney [4] for his studies made of photographs taken with kites before 1913.

## Aerial Photography for Cadastral and Geographical Surveys

Since the preceding paragraph was written there has been received a report on the employment of aerial photography for cadastral surveys and for geographic surveys. This report is an amplification of the matter treated in the 1917 annals with several important modifications and additions that are the results of further experience. It is to a certain extent a supplement to the earlier work. The two should be studied together.

The report consists of 116 quarto pages in four parts and is well illustrated with more than fifty figures drawn at liberal scales. The first part is devoted to a description of instruments and the results of a trial survey made to test the method. The second part deals with the procedure of the method, concrete evidence being presented in fair manual form. Details of the method as applicable to mapping at ordinary (1: 5,000 to 1: 20,000) scales are explained in the third part. In the fourth part is seen the influence of the trial survey. Here are mentioned the modifications that are to be made in the aerial camera to be used for cadastral surveys.

The survey was made to compare the aerial method with the ordinary ground method of conducting cadastral surveys. The map was drafted at the scale 1: 1,000, and, in spite of the difficulties encountered, the results are stated to have been more accurate (accidental errors are entirely eliminated) than those obtained by the ground method. The rate of progress was also greater by the aerial method than by the ground method. Elevations could not be determined from the negatives so accurately as by levels run on the ground. The cost of the aerial method did not compare with that by the ground method so favorably as did accuracy of locations and speed. The experience gained by the test led to a significant decision, namely, that aerial photographs intended for survey use ought to be taken by three joined cameras, so arranged that one chamber should point down, one obliquely sidewise, and one obliquely backward or forward. Photographs so taken with multiple cameras can be more readily employed, will give greater accuracy in results, and will cost less to obtain. This is an exceedingly interesting conclusion, for it corroborates conclusions which have been reached in this country after the making of studies and comprehensive tests.

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[3] Aimé Laussedat: Recherches sur les instruments, les méthodes et le dessin topographiques, Gauthier Villars, Paris, Part I, 1901, Part II, 1903.

[4] J. T. Saconney: Métrophotographie, O. Doin et Fils, Paris, 1913.

## Work of the U. S. Government Bureaus

The report of the Committee of the Board of Surveys and Maps published as an Information Circular by the Air Service is a résumé of work done by several bureaus of the Federal Government in connection with the use of aerial photography in mapping. The purpose of the report was to determine as clearly as possible how successfully aerial photographs could be used in topographic mapping and in surveys of coasts and what promise lay in future development. The report contains accounts of work done by the Navy, the Army, the U. S. Geological Survey, and the Coast and Geodetic Survey. Several examples of the practical application of aerial photographs are given. Among these are a revision of a coast chart to show changes of a shore line caused by storm action at Tucker Beach, N. J.; a revision of the Santa Monica quadrangle, California, showing great growth of the city of Los Angeles, Santa Monica, and near-by towns, during a period of twenty-five years; the preparation of field sheets of the Schoolcraft quadrangle, Michigan, to which contours are to be added by ordinary methods on the ground; and a plane map, based on land lines, of a quadrangle in Oklahoma which shows cultural development, drainage, and woodland areas. Specimens of mosaics and types of aerial photographs are also shown.

A section of the report is given to a description of aerial mapping cameras and the methods of their use. Problems connected with the application of aerial photography to map-making are treated under the headings: "Pilot's Duties," "Observer's Duties," and "Results of Tests at McCook Field, April-July, 1920."

The cost of making maps from aerial photographs is a difficult question to deal with. This is not the only branch of surveying which suffers from that distinction. All classes of surveys are hampered in many quarters of the globe by unfavorable weather. Weather is of extreme importance in obtaining aerial photographs. On the other hand it is possible with certain types of American aircraft cameras to photograph a thousand square miles in a single fair day with but one camera. Records of weather with regard for aerial photographic possibilities and costs of operating aircraft will undoubtedly after a time become available, so that satisfactory estimates of the cost of all phases of mapping with aerial photographs may be made. This time is to a certain extent anticipated by the report, and numerous items of cost incurred in getting aerial photographs are given.

Part II is a statement showing the possibilities of aerial photography in mapping, with the types of cameras available. Here is reproduced a small map of the United States which shows by shading those parts where relief is too great for aerial photographs to be successfully employed. About four-fifths of the country is represented as susceptible from the technical standpoint of being mapped by the use of aerial photographs.

The average vertical aerial photograph, which is but slightly inclined to the horizontal plane, may be used to measure angles from its center,

because lines drawn from the center to objects pictured represent fairly accurately the true bearings to the objects. So used the photograph is exactly the equivalent of a map which is mounted on a slightly tilted plane-table. By means of the three-point or of the tracing-paper method a fair location can be made of the point occupied with the plane-table, even though the plane-table be only approximately level. Having made the location of the station, the map can be satisfactorily oriented and any object in view can be sighted. The same sort of tracing-paper solution can be made to determine the position of the center of vertical aerial photographs, with reference to three or more known points that it embraces, by placing over the photograph a tracing of the known points and shifting it about until the points fall on their respective radial lines. When this is done, the tracing is properly oriented with respect to the photograph, and bearings to any object pictured can be traced. The centers of the photographs always correspond to the positions to be occupied.

This is the key to the use of vertical aerial photographs for mapping. It affords a means of extending surveys over considerable distances providing there is a base to start from and a point at the end to tie to. It is not uncommon, in reconnaissance and exploratory surveys, to extend maps by the plane-table intersection method for a hundred miles or more from a single comparatively short base. Extensions of maps by aerial photographs have been successfully made over distances as great as twenty miles; and, though the proof that similar extensions can be made over distances as great as a hundred miles is lacking, the evidence available indicates that there is only one thing that can hinder its being satisfactorily done, and that is excessive relief. For reconnaissance surveys the amount of relief which can be successfully coped with is roughly about 1,000 feet between two overlapping photographs, and this corresponds to about 1,000 feet in any mile of the course. A continuous rising and falling of the ground, if the slope be not greater than 1 in 5, would be no more difficult to map by aerial photography than the average rolling country.

The problem of determining elevations from aerial photographs to suffice for placing contours on maps is a complex one. With instruments and facilities now available the solution necessarily involves, and must be preceded by, the accurate location of points of control. To be practicable in moderate-scale surveys of large areas, this means that the necessary points of control must come in large part from the photographs themselves. This task is receiving the attention of mapping agencies of the Federal Government.

# THE POPULATION PROBLEM

By Raymond Pearl
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In the opening chapters of the first edition of his "Essay on the Principle of Population," T. R. Malthus said: "I think I may fairly make two postulata. First, That food is necessary to the existence of man. Secondly, That the passion between the sexes is necessary, and will remain nearly in its present state, . . . Assuming, then, my postulata as granted, I say, that the power of population is indefinitely greater than the power of the earth to produce subsistence for man." In the century and a quarter since these words were published the evidence not only of their truth but also of their profound wisdom has multiplied manyfold. Malthus could know as facts of experience, when he wrote in 1798, only what was behind him. What was to happen in the nineteenth century he could only conjecture.

Proceeding from the earliest to one of the most recent scientific studies of the problem of world population, it is to be noted that Griffith Taylor, in his original and thoughtful paper on "The Distribution of Future White Settlement" in the July, 1922, number of the *Geographical Review* envisages clearly the coming limitation of the earth's population, by reason of its saturation in respect of means of subsistence. The time factor in this population saturation, is one about which there may be difference of opinion. But it really matters little whether one takes Knibbs's estimate of 450 years quoted by Taylor, p. 402, or that author's own suggested figure of about two centuries or the perhaps even shorter estimate to which my own mathematical studies have tentatively led me. The important consideration is that population, so far as we know, always has grown and certainly is now growing at a rate which, if continued, will some time completely populate the habitable portions of the earth with a density which will be the maximum consistent with the continued existence of human beings.

## Explanation of Figure 1

Figure 1 of this article gives a picture of some aspects, at least, of what has happened since the beginning of the nineteenth century. It will pay us to examine it with some care, because it presents the problem that worried Malthus, as it exists here and now. It will appear with startling emphasis, that nothing which has happened since 1798 has in the least degree mitigated or softened or altered in any true sense the relentless insistence of Malthus's logic. On the contrary, the developments of the last century have made it far plainer even than it was to so clear-visioned a major prophet as he was, that the population of the world cannot go on increasing at

anything like the rate of growth that has prevailed in the past more than a short time longer.

This diagram is constructed from official figures, conveniently compiled in the annual volumes of the "Statistical Abstract of the United States." It is made according to the following plan. The absolute values for population and for the several other items of production, trade, and the like, included in the diagram, were taken as of value 100 in the year 1800, and then at each subsequent point on the diagram the absolute figures are reduced to relative values on the basis of the 1800 figure taken as 100. The only exception to this procedure is in the case of railways and telegraphs, which had not come into existence in a statistically significant sense in 1800. In those cases, the figures of their first appearance in the statistics (1830 in the case of railways, and 1850 in the case of telegraphs) are taken as 100, and the subsequent values are referred to the initial value as a base. The relative figures so obtained were then plotted on a logarithmic scale. The virtues of such a scale of plotting are, in the present case, twofold. In the first place, it enables us to include in one diagram of moderate dimensions the enormous range of variation exhibited by certain of the items. In the second place, it is a property of logarithmic charts that the *slopes* or trends of all lines are directly and visually comparable one with another. This is not true of charts plotted on an arithmetic scale, unless the absolute values plotted chance to be of approximately the same magnitude. The figures on the left hand margin of the diagram are to be interpreted in this way. If any relative value rises to the line marked 1,000, it means that the item exhibiting this figure has increased tenfold. If it rises to the line 10,000, it means that the item has increased, in the period covered, a hundredfold; if to the 100,000 line, it has increased a thousandfold.

The original data upon which the diagram is based, together with the calculated relative values, are presented in Table I. It is to be noted, as a matter of course, that the figures of Table I cannot possibly be meticulously accurate. They represent, in some of the items, only rough statistical estimates. But they cannot possibly be so far in error as to affect sensibly the general lesson which the diagram teaches.

## The World's Relative Progress in Population and Production

With these explanations of the construction of the diagram, we may proceed to see what it means. In the first place it appears that the world's population has increased in the century a little less than two and a half times. This is, in itself, not an extraordinary figure and would appear to be nothing to be in any way alarmed about. It is far smaller than the rate of population increase under special circumstances, where the population of a particularly favored area may double itself in fifteen to twenty years.

The point of real interest in the diagram, the thing which gave purpose to the writing of this article, is that *the slope of every other line on the chart is*

TABLE I—WORLD'S DEVELOPMENT OF POPULATION, PRODUCTION, VESSEL, TONNAGE, AND COMMERCE: 1800 TO 1918

| Year | Population | | Commerce total | | Tonnage sail and steam | | Railways | | Telegraphs | | Production of | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Cotton | | Coal | | Pig Iron | |
| | Absolute Millions | Relative | Absolute Millions | Relative | Absolute | Relative | Absolute Thousand miles | Relative | Absolute Thousand miles | Relative | Absolute Million Pounds | Relative | Absolute Million short tons | Relative | Absolute Million tons | Relative |
| 1800 | 640 | 100 | 1,479 | 100 | 4,026 | 100 | —— | —— | —— | —— | 520 | 100 | 11.6 | 100 | 0.8 | 100 |
| 1820 | 780 | 122 | 1,659 | 112 | 5,834 | 145 | —— | —— | —— | —— | 630 | 121 | 17.2 | 148 | 1.0 | 125 |
| 1830 | 847 | 132 | 1,981 | 134 | 7,211 | 179 | 0.2 | 100 | —— | —— | 820 | 158 | 25.1 | 216 | 1.8 | 225 |
| 1840 | 950 | 148 | 2,789 | 189 | 9,380 | 233 | 5.4 | 2,700 | —— | —— | 1,310 | 252 | 44.8 | 386 | 2.7 | 337 |
| 1850 | 1,075 | 168 | 4,049 | 274 | 12,334 | 306 | 24.0 | 12,000 | 5 | 100 | 1,435 | 276 | 81.4 | 702 | 4.7 | 587 |
| 1860 | 1,205 | 188 | 7,246 | 490 | 16,600 | 412 | 67.4 | 33,700 | 100 | 2,000 | 2,551 | 491 | 142.3 | 1,227 | 7.2 | 900 |
| 1870 | 1,310 | 205 | 10,663 | 721 | 15,940 | 396 | 139.9 | 69,950 | 281 | 5,620 | 2,775 | 534 | 213.4 | 1,840 | 11.9 | 1,487 |
| 1880 | 1,439 | 225 | 14,761 | 998 | 20,280 | 504 | 224.9 | 112,450 | 440 | 8,800 | 3,601 | 693 | 340.0 | 2,931 | 18.0 | 2,250 |
| 1890 | 1,488 | 233 | 17,519 | 1,185 | 17,461 | 434 | 390.0 | 195,000 | 768 | 15,360 | 5,600 | 1,077 | 466.0 | 4,017 | 27.2 | 3,400 |
| 1900 | 1,543 | 241 | 20,105 | 1,359 | 20,531 | 510 | 500.0 | 250,000 | 1,180 | 23,600 | 6,247 | 1,201 | 800.0 | 6,897 | 40.4 | 5,050 |
| 1906 | 1,579 | 247 | 27,148 | 1,854 | 25,522 | 634 | 564.0 | 282,000 | 1,200 | 24,000 | 7,650 | 1,471 | 885.0 | 7,629 | 58.7 | 7,337 |
| 1910 | 1,616 | 253 | 33,634 | 2,274 | 26,670 | 662 | 637.0 | 318,500 | 1,307 | 26,140 | 9,013 | 1,733 | 1,141.6 | 9,841 | 65.8 | 8,225 |
| 1911 | 1,630 | 255 | 35,959 | 2,428 | 28,298 | 703 | 666.0 | 333,000 | 1,356 | 27,120 | 10,634 | 2,045 | 1,309.6 | 11,290 | 62.4 | 7,800 |
| 1912 | 1,643 | 257 | 39,570 | 2,675 | 29,061 | 722 | 683.4 | 341,700 | 1,400 | 28,000 | 10,301 | 1,981 | 1,377.0 | 11,871 | 72.8 | 9,100 |
| 1913 | 1,652 | 258 | 40,420 | 2,733 | 30,408 | 755 | 690.2 | 345,100 | 1,462 | 29,240 | 10,809 | 2,079 | 1,478.0 | 12,741 | 77.9 | 9,737 |
| 1914 | 1,661 | 260 | 37,760 | 2,553 | 31,674 | 787 | 703.5 | 351,750 | 1,489 | 29,780 | 11,933 | 2,295 | 1,346.0 | 11,603 | 56.8 | 7,100 |
| 1915 | 1,672 | 261 | 31,302 | 2,116 | 31,693 | 787 | 717.5 | 358,750 | 1,526 | 30,520 | 8,805 | 1,693 | 1,169.6 | 10,083 | 59.0 | 7,375 |
| 1916 | 1,692 | 264 | 46,523 | 3,146 | 31,293 | 777 | 720.3 | 360,150 | 1,564 | 31,280 | 9,047 | 1,740 | 1,242.9 | 10,715 | 71.4 | 8,925 |
| 1917 | 1,693 | 265 | 52,781 | 3,569 | 29,805 | 740 | 729.8 | 364,900 | 1,568 | 31,360 | 8,705 | 1,674 | 1,317.9 | 11,361 | 64.6 | 8,075 |
| 1918 | 1,699 | 265 | 62,802 | 4,246 | 31,139 | 773 | 732.8 | 366,400 | 1,586 | 31,720 | 8,845 | 1,701 | —— | —— | 62.0 | 7,750 |

*far steeper than that of the population line.* Thus it appears that, while the population was increasing two and a half times, the world's coal production and pig iron production increased from fifty to seventy times and by 1917 had increased nearly 100 fold over the conditions of 1800. The world's cotton production increased in the same period twentyfold; the world's

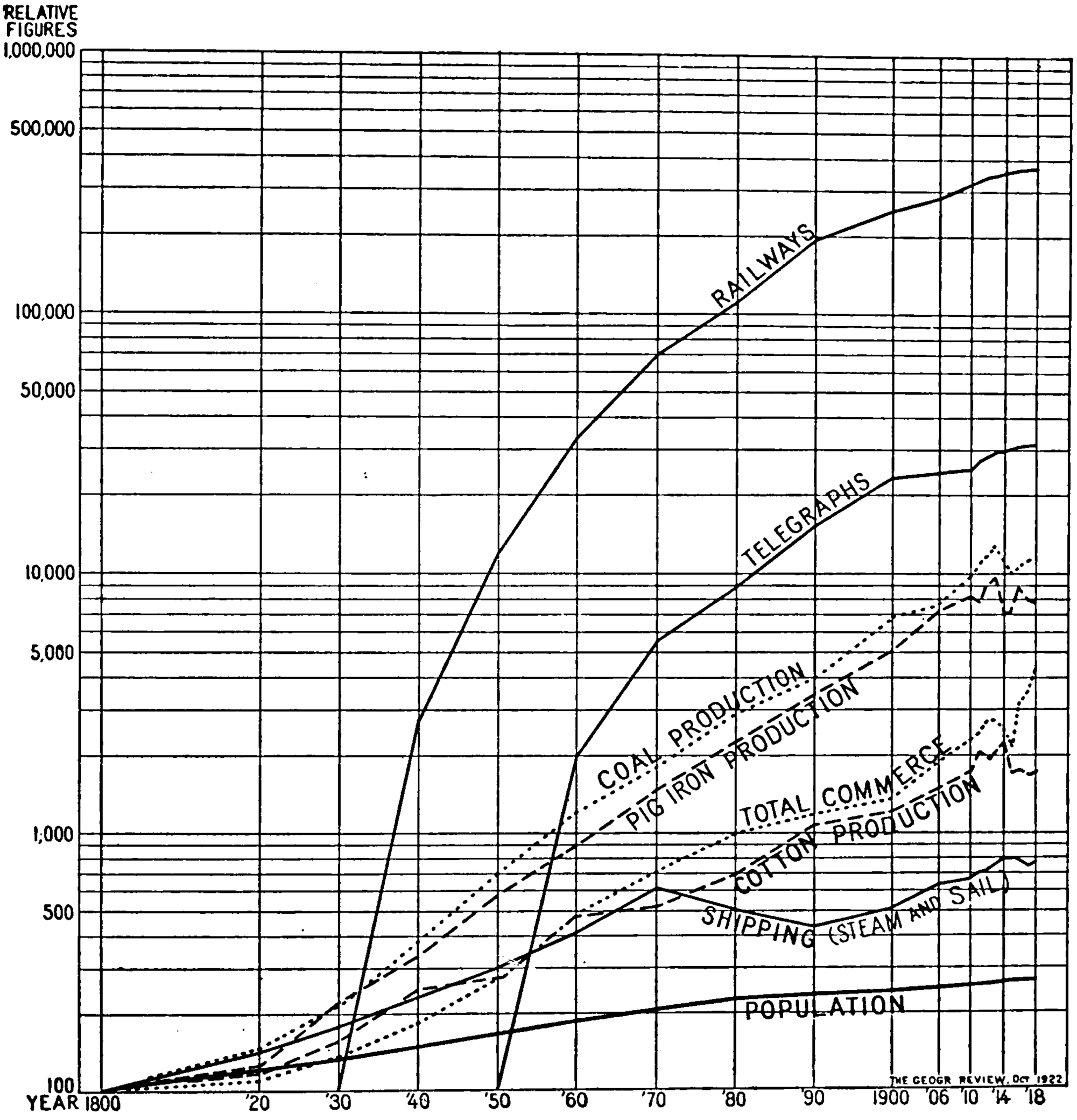


FIG. 1—Diagram showing the progress of the World's population and production of certain materials in the nineteenth century.

commerce, a little more than that; the world's shipping increased something like eightfold, while the railway mileage increased, in the period from 1830 to 1917, by roughly 3,000 fold, and the telegraphs 300 fold.

In the face of such figures as these, one may well ask, "Where are we going?" No sensible person will, for a moment, suppose that such lines of this diagram as those for cotton production, coal production, or pig iron production can go on indefinitely increasing at the rate shown in the 117 years covered. It would be manifestly absurd. Yet, on the other hand, it must be remembered that these figures are world figures, approximate if one pleases, but on the whole certainly not far from the true, unknown, facts. This consideration means that the population of the world, in one

way or another, has used up in the business of carrying on its life all of the coal, all of the pig iron, and all of the cotton for which the production trends are indicated on the diagram. There is no such thing as "interworld" trade. Therefore it cannot be asserted that a part of this production went for export and consequently need not be worried about. Trade relations have still to be established with the other planets. When we look at the facts of *world* production, we are also, and implicitly, setting before ourselves the data of *world* consumption, using consumption in the broad sense of usage plus wastage.

Now it appears equally to be true that the whole fiber of our social organization is bound up with the consumption of about the indicated amounts of products. In other words, so much coal and so much pig iron and so much cotton were produced in the last century because the world's people needed them, or, at least, thought they needed them to maintain and continue their lives, individually and collectively, in the way they were doing and presumably wanted to do. Put in another way, there seems no escape from the conclusion that the present stage of the development of the world's civilization requires about the ratios of production to population shown on the chart in order to maintain itself and continue at its present standards of living.

But there at once follows a most significant corollary from this. If it be granted that the coal and pig iron lines, for example, cannot by any possibility be projected for another century or two along the same lines that their production has followed during the past century, then it must be that, unless the rate of increase of population slows up, the ratio between the production of these goods and the population which has been maintained in the past cannot possibly be continued in the future.

There may be those inclined to interpret the diagram in a directly opposite way; who will say that, since a given population is now able to produce, owing to all the developments of knowledge which have occurred, such vastly greater quantities of all these necessities than they were able to in 1800, there appears no reason why the process should not go on at the same rate in the next century that it has in the one just past, it being presumed that mankind will increase in the organized intelligence and awareness which constitutes applied science. This view overlooks the fact that besides the human element involved in production, there is another of even greater importance which finally limits the process. It is, that the volume and the surface of the planet on which we live are strictly fixed quantities. This fact sets a limit, if no other does, to the indefinite projection of these straight lines of production trend which make angles of 30 to 45 degrees with the horizontal. For example, one would not have to project the coal production line, along the course it has followed during the nineteenth century, over many years before it would reach a point where it would indicate a produced tonnage such that the entire globe would have to be solid coal to permit of its realization. Eventually there must come a turn in these

production lines. One suspects that it may have already come in the case of pig iron and cotton.

The curves for railways and telegraphs are interesting in this connection. On the whole, the world has finished the major portion of its railway building. There will, of course, be many more miles of railway built as time goes on; but the additions will clearly be at a much slower rate than has been the case from 1830 up to the present time. In other words, the world is nearing a stage of saturation in respect of railways. It has, roughly speaking, about all it needs.

## Trends of the World's Food Production

So far nothing has been said about food, the most important single item in human subsistence. We come here upon much less secure ground, statistically speaking, because there are no particularly accurate world figures for even the most important of crops. The data that are available are distinctly rough estimates, except in the case of sugar, where, owing to the nature of the manufacturing processes involved, the total production is rather accurately known. For the other crops the estimates are, in general, simply the summed returns from countries which have a system of agricultural statistics. Probably this leaves out a significant proportion of the total production. But there is every reason to believe that the *trends* shown by the figures which are available are substantially in accord with what would be shown if accurate total figures were at hand. Inasmuch as it is only the general trend of the figures that we are interested in for the present purposes, the data set forth in Table II will suffice. The data are shown graphically in Figure 2.

From Figure 2 it appears that a process is going on in world food production which is precisely the same in kind, though different in degree, as is shown in Figure 1 for the production of other things than food. Until 1916 the food production curves were rising *at a more rapid rate* than the population curve. In the last three years of the chart the upsetting conditions of the war, combined with unfavorable seasons in many regions, caused an abrupt fall in the world's food production. But, leaving these years out of account, it is plain that the world's food consumption (for here as before production means consumption, in the broad sense, when we take the world as a whole) has increased faster in the last 20 years than has population. This is particularly marked in the case of the commodity sugar, which in some degree may be regarded as a food luxury.

It will be understood, of course, that not the whole of any one of the crops shown in Figure 1, is *directly* consumed as human food. In some cases, notably corn, the fraction that is thus directly consumed by human beings is relatively small. But indirectly and in converted form, through animals and manufactured products, the bulk of all edible farm crops contributes in greater or less degree to human nutrition. We eat the corn in the form

of pork, we drink (or did drink) a good deal of barley as beer, we eat some of the oats as oatmeal, some as eggs, some as milk, and so on.

Now, a superficial view of the situation revealed in Figures 1 and 2 is likely to be extremely complacent. Population has grown since Malthus's day. Yes, about as he said it would. But Malthus quite overlooked the powers of man himself to make nature do his will. As the population has increased man has made the means of subsistence increase still faster. So far from population catching up with the means of subsistence, it is plainly out-distanced in the race. So will the unthinking interpret our charts.

TABLE II—WORLD PRODUCTION OF PRINCIPAL FOOD CROPS

| YEAR | CORN | WHEAT | OATS | BARLEY | RYE | POTATOES | SUGAR |
|---|---|---|---|---|---|---|---|
| | MILLION BUSHELS | MILLION BUSHELS | MILLION BUSHELS | MILLION BUSHELS | MILLION BUSHELS | MILLION BUSHELS | MILLION POUNDS |
| 1895 | 2,835 | 2,593 | 3,008 | 916 | 1,468 | —— | 17,779 |
| 1900 | 2,793 | 2,641 | 3,166 | 960 | 1,558 | 4,382 | 19,370 |
| 1905 | 3,461 | 3,327 | 3,510 | 1,180 | 1,496 | 5,255 | 21,310 |
| 1910 | 4,032 | 3,575 | 4,182 | 1,389 | 1,673 | 5,275 | 33,415 |
| 1911 | 3,461 | 3,541 | 3,786 | 1,375 | 1,579 | 4,749 | 38,083 |
| 1912 | 4,055 | 3,760 | 4,585 | 1,457 | 1,901 | 5,873 | 35,585 |
| 1913 | 3,587 | 4,127 | 4,697 | 1,650 | 1,880 | 5,803 | 40,788 |
| 1914 | 3,878 | 3,486 | 4,035 | 1,463 | 1,597 | —— | 41,972 |
| 1915 | 4,213 | 4,173 | 4,389 | 1,560 | 1,586 | 3,044 | 41,512 |
| 1916 | 3,101 | 2,279 | 3,941 | 1,437 | 530 | 1,720 | 37,069 |
| 1917 | 3,483 | 2,224 | 2,975 | 914 | 434 | 2,734 | 37,729 |
| 1918 | 3,038 | 2,818 | 3,052 | 1,077 | 529 | —— | 38,375 |

But we are unable to convince ourselves that such complacency has any warrant. We believe that anyone who will take the trouble to read even the present article carefully and will ponder over the *facts* it presents, rejecting if he likes everything that savors of opinion or theory, will be bound to feel some misgivings about the world's ability to go on indefinitely increasing both its population and its average standard of consumption or of living. For precisely that is what we are now doing. The steeper slopes of the production with the population line can only mean (recalling always that we are dealing with the world figures) that the ratio of consumption to population has been steadily widening. But a widened consumption ratio represents a more extravagant standard of living. It can, broadly speaking, mean nothing else. If people, taken at random, consume (use and waste) more goods now than people did say 20 years ago, then plainly their standard of consumption has gone up.

## RESULTS OF OTHER STUDIES

Space will not permit any exhaustive review of the literature, but the author of the present article desires to quote briefly from two recent writers

on the general subject of population, in order to show that he does not stand alone in the views suggested. One of the most careful and thorough of recent students of the problem is Thompson. In rounding up the results of his study he says:

> Another conclusion which seems to me to be warranted is that population cannot continue to increase at its present rate without being more and more subjected to the actual want of food, provided the distribution of labor between agriculture and the non-agricultural industries continues in its present trend (the trend found in the more highly developed countries). Nor can a greater and greater proportion of the population be devoted to agriculture and the present rate of increase continue without checking a progressive standard of living. The non-agricultural industries are not yielding increasing returns in such ratio that they can furnish the necessary material means for a progressive standard to such a rapidly increasing population. Thus whatever the direction of development, a progressive standard of life and a population increasing from 1.5 per cent to 2.0 per cent a year cannot go on together for long, in a large part of the world. Therefore, either our present standard of living must be simplified as an increasing proportion of the population becomes rural or the present rate of increase of population must be lowered. Probably both must take place in order to have a really progressive civilization.
>
> To simplify our present standards of living does not necessarily mean a lowering of them. It means rather that a good many of the things of our civilization which we consider essential today may be found to be merely passing phases, induced by our rapid industrial development. We have become accustomed to think of civilization and culture and progress as of necessity involving all the complexities of our present existence. It is open to question, however, whether much of our present complexity is not a hindrance to real culture rather than an aid. There cannot be much doubt that as people are becoming more educated they are becoming more self-contained, and they begin to see that the way to get the most out of life is to put the most into it, and not to surround themselves with all the luxuries and baubles they can afford.
>
> But it is doubtful whether even such a simplification of life of the people of the more highly civilized nations will enable them to support in comparative comfort an ever-increasing proportion of their populations, or even the same proportion as at present, if it is not accompanied by a lower rate of natural increase of population. A slower rate of increase of population will give more time to adjust standards of life to surrounding conditions and to direct the course of progress; without it most of our efforts must be directed towards the more pressing of the problems of our present-day life. A greater and

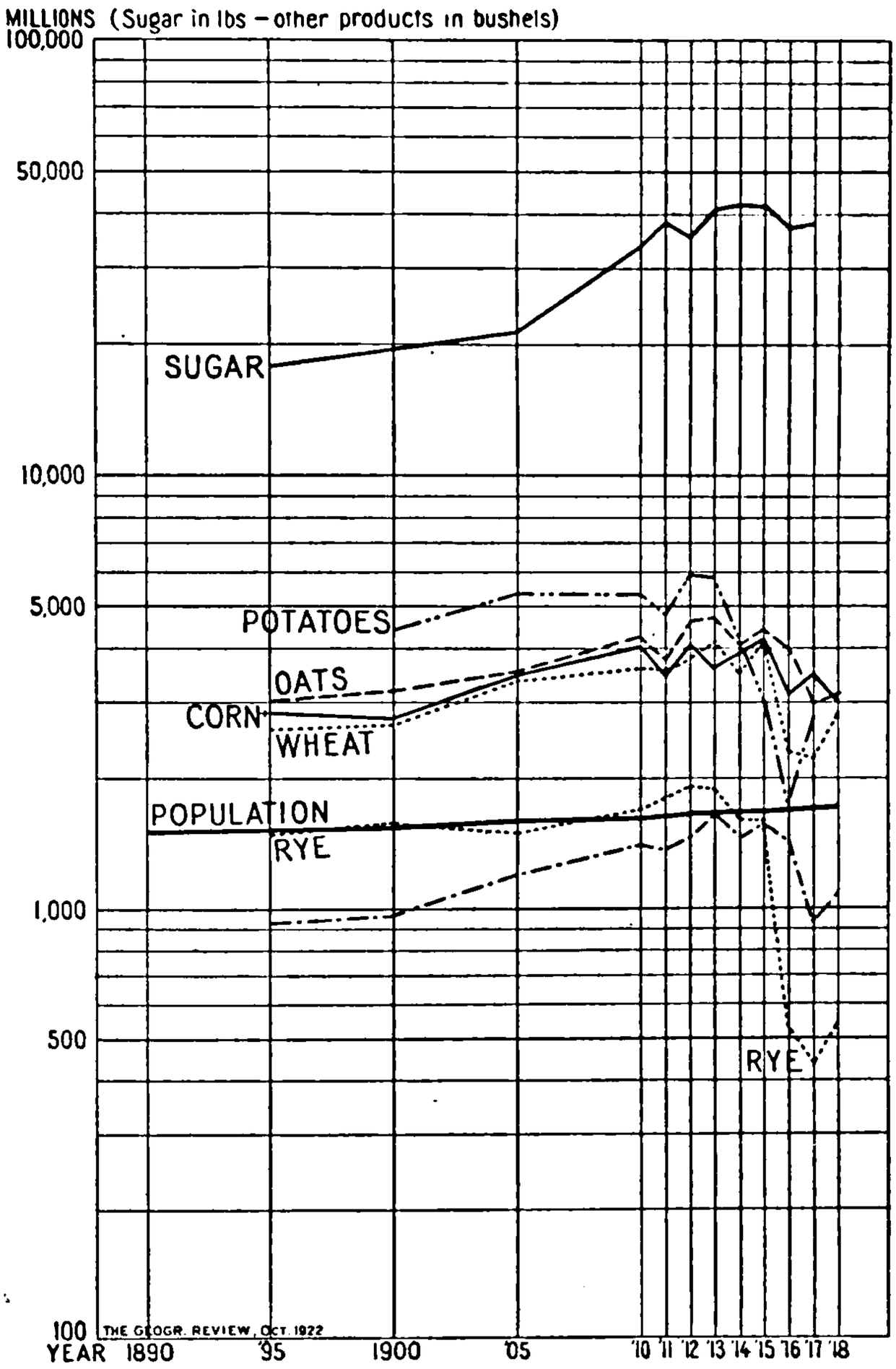


FIG. 2—Diagram showing progress in world food production in relation to population.

greater control over the growth of population is essential to a growth of rational social control.[1]

Another leading student of the problem, East, has this to say in a recent paper:

> Let us think in terms of land. A careful study of the available statistics shows that, by and large, it takes about 2.5 acres to support each individual. Some self-supporting nations can make out with less, but only when they put all their efforts into cultivating their richest land; others with less efficient methods take much more. Taking this as the average figure, then, it is necessary to plow, plant, cultivate, or otherwise tend, some 37 million acres more land each year than was ever so treated before, if the nations of the earth are not to go hungry.
>
> It is a curious illustration of the general tendency of people to be optimistic about everything, that even many of our most eminent economists believe this wresting of additional food from the soil to be an easy task. They draw wonderful pictures of what science has done in the past few years, make roseate prophecies of similar advances in the future, and keep everyone happy with the idea that the human race has unlimited credit on Nature's bank. Never was logic more fallacious. The total land area of the globe, 33,000 million acres, seems large, it is true, but one cannot utilize all this area for raising crops. Take out the mountains, the deserts, the undrainable swamps, in short the areas not available for agriculture, and there is left about 13,000 million acres. Of this potential world farm some 5,000 million acres are now being cared for by the hand of man. According to our previous calculations, then, the maximum population the earth can support is a little over 5,000 millions. And here is the heart of the matter—the time when this important event would take place at the present rate of increase is not so far distant but that some of our grandchildren would live to see it. Mind, I do not say the world is going to fill up and run over like a tub within the next century or so. Of course it is not. The difficulties of digging out a living, the positive checks to population, will see to it that the present rate of increase diminishes, even if no other checks intervene. I am merely showing the meaning of this speed.
>
> In the second place, human genius is not doing for agriculture just what our economists seem to think. The industrialization of the Caucasian world which has gone on at such a rapid pace during the last fifty years has provided for more people, it is true. In fact, population increase, though rapidly rising, has not really caught up with the increase in production made possible by the multitude of mechanical inventions. But why has this come about? There is one reason and only one reason for the situation. We have had a reserve of new land to draw upon. Mechanical invention simply made it possible for a given unit of man power to cultivate more land and to distribute its products more rapidly and equitably. With the exception of the credit to be given the mechanical production of chemical fertilizers, thus far negligible in a world-sense, the Age of Steel has not aided agriculture one iota, when computation is made on unit area. In other words, the provisions John Doe raises on his hundred-acre farm have not been increased because of traction plows and steam threshers. But John Doe has had cheap land available and has been able to cultivate more of it than he could by the old hand methods. Yields per acre were actually decreased. What will happen when the new land gives out? It is giving out, giving out rapidly. Well, the result will simply be this: the machine farmer will give way to the hand farmer. The American who now cultivates 26 acres per capita will have to put more man power into his efforts and will approach the Belgian standard of 5 acres per capita. He will get greater yields on a given acre by so doing, even as the Belgian farmer gets greater yields, but the yield per capita will sink slowly downward. So few people seem to appreciate this difference of standard. They look at the English yields of wheat and

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[1] W. S. Thompson: Population: A Study in Malthusianism (Columbia Univ. Studies in Hist., Econ. and Public Law, Vol. 73, No. 3), New York, 1915, pp. 163-165.

German yields of potatoes and wonder why the yields per acre in the United States are so low. They are low simply because the United States has had new lands to exploit. The country has been in an era of "increasing returns;" when shallow plowing, incomplete cultivation, and other cheap extensive methods would still yield a fair profit. European agriculture, on the other hand, has long been experiencing the pain of "decreasing returns." Year by year they have been faced with the necessity of getting more and more out of their land, to pay the mounting rentals. They have succeeded remarkably well; but they have only had this success because they have put more toil, more man power into their work. We are now entering on this era of diminishing returns per person in this country. Our yields per acre are rising and will continue to rise. But they will rise because of the increased effort put into the work rather than because of new methods of tilling and of time-saving devices.[2]

These quotations from two of the leading investigators of the problem of population at the present time will be sufficient, it is thought, to indicate that the author is not alone in supposing that this is a real problem, perhaps the most significant one facing mankind today.

It is not my purpose in the present article to do any more than present the general problem. With my colleague, Dr. Lowell J. Reed, I have in preparation a book on the subject, in which the detailed facts as to population growth in various countries will be presented, together with a mathematical theory of population growth, which may be of value in approaching the solution of the world-wide and pressing problem.

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[2] E. M. East: Future Food Prospects, *World Agriculture*, Vol. 2, 1921, pp. 130–132.

# ON THE FUTURE DISTRIBUTION OF WHITE SETTLEMENT

By WALTER F. WILLCOX
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At the request of the Editor of the *Geographical Review* I send these brief comments on Professor Taylor's thoughtful and thought-provoking article, "The Distribution of Future White Settlement," in the July number. The main issue between Professor Taylor and me probably lies in our differing answers to his fundamental question, which is this: Assuming that accidental and artificial influences upon the distribution and density of the white population of the earth are destined to become in future less potent, and this I concede only for the purpose of raising the main issue, will physiographic influences, such as temperature, rainfall, altitude, and coal supply, become dominant and in combination fix the future distribution and density of the earth's white population? This question Professor Taylor answers in the affirmative. My answer would be, We cannot tell.

The view which seems to me defensible as an alternative to his, even in face of his evidence, is that, if the artificial influences become less potent, human and social influences, conscious and unconscious, are likely to compete with physiographic influences in filling the void.

Temperature escapes human control, but wheat does not. There is a hybrid variety of wheat, Marquis, which was first bred less than twenty years ago and which ripens earlier than competing varieties. In 1918 this variety yielded in Canada alone a crop of 129 million bushels and had pushed the area for the profitable growing of wheat farther into the Canadian Northwest. In my opinion there is doubt whether the whites will continue to be tied as closely as now to wheat for their main food and more doubt whether wheat will remain limited to its past and present range.

With scientific agriculture and especially its practical applications still in their infancy, I cannot foresee what developments will come from them nor how far man with the help of this potent agent can modify the production of food in various areas. If in the last half century or more the centers of agricultural production in Australia had shifted as far as they have in the United States, perhaps Professor Taylor would be less ready to assume a static agriculture through the next few centuries.

At another point I dissent even more confidently. He says "Health is controlled primarily by temperature and humidity." In my opinion it is not controlled by any one or two influences but is affected by individual, family, and social action more than it is by natural conditions. The motto of the New York State Department of Health: "Public health is purchasable; within limits a community can have the death rate it is willing to pay for" seems to me nearer the truth and more likely to be serviceable to mankind than the somewhat fatalistic dogma, "Health is controlled primarily by temperature and humidity."

Professor Taylor says: "The world as a whole has doubled its population during the last ninety years." The statement made with the presentation of no evidence and the mention of no authority illustrates the author's fondness for sweeping generalizations inadequately supported. My own recent study of the growth of the world's population led me to conclude that since the middle of the eighteenth century it has been rapidly increasing and is now perhaps two thirds larger than then. I doubt that during the last ninety years its increase has been greater than 50 per cent.

In the same connection Professor Taylor discussed briefly the growth of American population where the facts are well established. He wrote:

"The population of the United States has been doubling itself approximately each thirty years during the last century. It was 25 millions in 1850, 50 millions in 1880, and 100 millions in 1910. If this rate of increase continue, it will have grown to the 700 millions mentioned in Table VII in less than one hundred years."

The figures and increases are as follows.

POPULATION OF THE UNITED STATES IN MILLIONS

| Year | Same Area | With Territorial Accessions | Increase in 30 Years | |
|---|---|---|---|---|
| | | | Amount | Percentage |
| 1850 | 23.19 | 23.19 | | |
| 1880 | 50.16 | 50.16 | 26.97 | 116 |
| 1910 | 91.97 | 101.15 | 41.81 | 83 |

To round 23.2 millions to 25 millions is a questionable procedure but less so than to raise a figure of less than 92 millions to 100 millions or to count the population of the Philippine Islands (7⅔ millions in 1903) as a part of the increase in the population of the United States between 1880 and 1910. The figures in the last column of the table show how wide of the truth is the statement that the population of the United States has been doubling every thirty years. Few facts about our population are better established or of greater importance than its slackening rate of growth since 1860.

May I put on record here my sceptical attitude towards any and all efforts to determine the population of the earth or any large part of it for more than a few years ahead, whether the method employed be one of subtle mathematical analysis, or merely the assumption that conditions and changes of the recent past will continue for some time? To my mind the largest population fact of the present day is the decreasing birth rate, due in the main to volitional control. It is because of this new phenomenon, I believe, that we stand at the threshold of a new era in the history of population. I doubt that we can gain much by striving to foresee how population will grow through coming generations or how it will be distributed in the remote future after this new agency has worked out its results and man has become thereby more and not less the master of his fate.

# GEOGRAPHICAL RECORD

## AMERICAN GEOGRAPHICAL SOCIETY

**Presentation of the Charles P. Daly Medal to Sir Francis Younghusband.** Announcement of the award of the Charles P. Daly Medal of the American Geographical Society to Lieutenant-Colonel Sir Francis Younghusband, President of the Royal Geographical Society, was made in the July number of the *Geographical Review*. The presentation of the medal took place on July 19 at the American Embassy in London.

In presenting the medal the Ambassador referred briefly to the circumstances under which the award was established, to the accomplishments for which it was bestowed, and to the previous holders, making felicitous reference to the merits of the present recipient. In response, Colonel Sir Francis Younghusband expressed his appreciation of the medal, which he likened to the embodiment in gold of the friendly spirit which he met with in his visit to the United States in 1914. The Earl of Winterton, who had been designated by the Secretary of State for India to represent him, then proposed a vote of thanks to the Ambassador, which was seconded by Sir Maurice de Bunsen on behalf of the Council of the Royal Geographical Society.

## EUROPE

**The Geographical Factor in Spanish Civilization.** In a scholarly volume full of new points of view Emilio H. del Villar seeks an explanation of the lowly estate of Spain among the civilized nations of today ("El valor geográfico de España: Ensayo de ecética. Estudio comparativo de las condiciones naturales del país para el desarrollo de la vida humana y la civilización," Madrid, 1921). Del Villar is not satisfied that it is due to her religion or bad government. When Spain was the greatest country in Europe she was just as catholic and just as monarchial as she is today, and then she easily outclassed the northern nations that now excel her. He thinks it absurd to say the Spaniard is not a worker. He emphasizes the part played by the environment which he calls the "geographic factor."

He devotes half his book to examining this geographic factor at work in the United States—an unusually favorable country for its study; in Europe—the region of fullest knowledge and home of many interesting nations; and in South America—a region of recent development. The other half applies the method of study so formed to Spain.

The eastern central region of the United States has the great population densities and the great city groups, rising to maximum intensity in the belt between Washington and Boston. Agricultural production is high there, but by no means coincident with the densest population. Mining, important as almost nowhere else in the world in many parts of the United States, promotes neither density of population nor the growth of cities. Much of it is carried on in the sparsely settled regions of the West. Iron is enormously abundant, but the ores occur quite apart from the centers of population. The coal beds, also magnificent, are nearer the great centers, but none are within the dense eastern belt. But the manufacture of iron from its ore is carried on near the coal, especially in the dense eastern coast belt.

This amounts to a law or principle. In lands of summer rain and abundant crops the places where minerals are refined and manufactured are the places where the most varied manufactures will be carried on, especially if there is good access to the ocean, the pathway of commerce. Here it is that great population masses and great cities are bound to arise. In Del Villar's phrase this gives high *ecetic* value, conduces to a high degree of habitability.

In Europe are found the same conditions. The great city and population masses there constitute a sub-Nordic zone consisting of the Scotch Lowlands, England, the north of France, Belgium, Holland, western and central Germany, and—in a decreasing degree—Denmark; a summer-rain region like eastern North America, producing abundantly without irrigation, a hay-and-fodder country with many cattle and large cereal and vegetable crops. This zone has much coal and iron also, which it works up on the coal or near by at convenient seaports, developing manufactures of vast importance with raw materials brought from far and near.

Spain has a thinner population and few cities. It lies in an outer, Mediterranean zone. Only the north has summer rain and abundant, moisture-loving growths. The rest of Spain is dry, a land of winter rain and woody thickets, needing the help of irrigation to become productive. Moreover, this scrubland has a very thin soil and has been widely "desertized" both by the removal of the scrub and the exhausting of the thin layer of humus by wheat growing. This condition, widespread in Mediterranean regions, is accompanied and aggravated by destructive hillside erosion which annually invades greater and greater expanses. Del Villar proposes as a remedy less wheat, more fodder, more cattle, more manure—to be applied in connection with chemical fertilizers—to restore the humus. Regions that invite tree crops—almonds, chestnuts, walnuts, and olives—have grown too much wheat, which Spain should have learned long since to seek in the better wheat lands of America.

Obviously it is a difficult thing to change a nation's crops, yet Del Villar must know that the Danes were obliged by American competition to make the same shift from grain to cattle raising and made it successfully. An interesting step in that change of Danish agriculture was the founding of agricultural high schools to enable the people to learn the new business. In this respect the geographical factor was crowding both Spain and Denmark, and the difference in the present prosperity of the two countries seems due to the energetic reaction of the Danes to this crowding and the very slight reaction of the Spaniards. Del Villar is right in drawing attention to the geographic factor, but he seems to minimize the human one. The Spaniard is the most important item in the Spanish environment. Take the case of the olive tree, one of nature's kindest gifts to Spain. According to Theobald Fischer ("Der Ölbaum," Gotha, 1904) the Spanish crop of oil in 1890 was 3,070,000 hectoliters, the Italian 1,300,000, the French 300,000. But the price paid for a hectoliter of Spanish oil was $13; for the Italian, $30; and for the French, $32. "It corresponds to the state of Spanish agriculture and general culture that Spain produces the finest trees and excellent olives but very low-grade olive oil." "The treatment of the tree and fruit and the method of extracting the oil [in Spain] are for the most part so primitive that of late enterprising Frenchmen and Italians go to Andalusia in Spain and have the olives picked and pressed under their own supervision to get really good oil." If the Spaniards could have got the French price for their crop of 3,000,000 hectoliters, they would have added $57,000,000 to its value, more than twice as much as Spain's total expense for education in 1920.

The government does not gather correct statistics, does not accurately inform itself of the facts. It does not help its people adjust themselves to a new condition and leaves 59 per cent of them today illiterate.

Besides not having rain enough for a dense population Spain lacks coal. She has very valuable mineral deposits, especially iron ores, but little coal, producing 4,000,000 tons in 1913 and importing 3,000,000 to make up its consumption of 7,000,000. That is very little indeed compared with the United States or Germany or England. Spanish water power may be equivalent to 20,000,000 tons of coal—estimates differ enormously. The study of the United States and Europe suggests that the mere presence of minerals will not create large population centers. It is the reduction and manufacture of iron and other minerals together with the allied manufacturing that have so much ecetic importance. But Spain is deprived of the favorable effects of the possession of ores by what Del Villar calls the *restrictive action of the optimum*. An optimum is a country of high ecetic value. In Spain's case the optimum is England. It restricted the activities of Spain by purchasing Spanish iron ores and taking them away to smelt and manufacture with the abundant English coal. English capital conducts even the mining operations in Spain, increasing the density of population and making cities grow in England instead of in Spain. In the same way England is enabled to draw from all parts of the British Empire and from other countries as well. We are invited to see the ground of Spain's inferiority in Spain's defective geographic factors.

But if our sense of the Spanish environment as a trying one is heightened we yet are not shown the Spaniard making a very adequate effort to dominate it.

MARK JEFFERSON

**Group Cities of Great Britain.** The 1921 census of Great Britain shows not only a population of city dwellers but of dwellers in large cities. Over 50 per cent of the population lives in cities or group cities of over 100,000 (the approximate percentage in the United States

is 26); over 35 per cent in the great urban aggregates of over 1,000,000. This phase of population distribution is discussed by Mr. C. B. Fawcett in an article "British Conurbations in 1921" in the May number of the (British) *Sociological Review*. The phenomenon of conurbations, or group cities, is of recent origin, an outgrowth of modern industrial life. Conurbations usually arise by the simultaneous expansion of a number of neighboring towns which coalesce into one continuous urban area. A peculiar opportunity for such development in Great Britain is afforded by the unique concentration of population on the coal fields (compare Mark Jefferson: The Distribution of British Cities, and the Empire, *Geogr. Rev.*, Vol. 4, 1917, pp. 387–394). Five of the seven British conurbations of the first magnitude are on the coal fields. The population of these and the smaller group cities has been computed from the census figures for districts officially classed as urban. It is not exact but the best that can be done with available statistics. Continuity of urban occupation is the criterion in determination of the area of the conurbation; but, as Professor Jefferson has pointed out in discussing the same phenomenon in the United States ("Great Cities of the United States, 1920," *Geogr. Rev.*, Vol. 11, 1921, pp. 437–441), difficulties arise in particular cases, and there local knowledge is necessary.

The population of the London conurbation is given as that of the Greater London of the census (the City and the Metropolitan Police Districts). It numbers 7,476,168. Professor Jefferson gives 6,657,447 for the New York group city. The Liverpool conurbation is the urban area occupied by workers of the Port of Liverpool and those dependent on them and subsidiary industries of the port. Its 1,194,780 people are concentrated about the harbor of the Mersey mouth in an unusually compact manner. Manchester, the largest of the coal-field conurbations, occupies the upper basin of the Mersey and numbers 2,351,156, including an inner city, Manchester and Salford, with somewhat less than half the population, and an outer ring. The Birmingham group is comprised by the Black Country: it focusses on this city which numbers about half the group population of 1,707,442. Glasgow includes the greater part of the population of 1,243, 746 constituting the conurbation of the lower Clyde valley. The Tyneside conurbation, with 845,886 people, like that of Liverpool occupies the shores of a single harbor. Newcastle upon Tyne, the largest and most central unit, is its natural focus. The West Yorkshire group (1,380,438) lying on the Pennine foothills of the West Yorkshire coal field is the least compact and least unified of the great conurbations. Leeds is the chief city, but it does not dominate its group as is the case with the chief cities of the other groups. It illustrates well the peculiar social problems before the conurbation, compounded as it commonly is of distinct and independent governmental units which have not realized their community of interests.

**Modifications in the Western Boundary of Hungary.** According to the Treaty of Trianon, Article 27 (see "The New Boundaries of Hungary," *Geogr. Rev.*, Vol. 10, 1920, pp. 408–412, with insert map scale 1: 1,500,000), the territory known as Burgenland was assigned to Austria because its population is predominantly German. But when the time came to transfer authority from one sovereignty to the other, the Hungarian government, and the local authorities as well, opposed the measure on the ground that the population opposed a change of control and that the region was historically Hungarian. To settle the dispute a conference was held to which Hungary was invited, and there resulted the Protocol of Venice, October, 1921. This document called upon the insurgent bands that had sprung up at many centers to lay down their arms, after which the Austrian government was to take possession. Allied generals were to sit at Sopron and supervise a plebiscite; and both Austria and Hungary pledged themselves to abide by the results. In sympathy with the vote the Conference of Ambassadors assigned to Hungary the town and district of Ödenburg. A further complication has now arisen in the settlement of the Burgenland dispute because the Delimitation Commission, specially appointed by the Peace Conference to establish the Burgenland boundary, has proposed, after a careful study of the whole frontier, that three additional districts should also be given to Hungary as follows: (1) the area around the village of Pamhagen, because it controls a system of irrigation and navigation canals affecting a wide area of Hungary; (2) a group of villages east and southeast of Liebing, because they gravitate around the town of Güns which remains in Hungary; (3) a narrow strip of territory, from 20 to 25 kilometers long, west of the town of Steinamanger, because its economic center is in Hungary. But the Austrian government has objected to these proposed changes in favor of Hungary though it informed the Conference of Ambassadors that it would accept any arrangement that the Council of the League of Nations might

make provided that it were made unanimously. The next step will be a study and recommendation by the Council before the Delimitation Commission can continue its work.

The Council of the League has also to consider changes recommended by the boundary commission that is establishing the line between Hungary on the one hand and Rumania and Yugo-Slavia on the other. The commission finds it necessary to depart from the terms of the treaty in some details, a contingency that was foreseen by the treaty makers who provided a means for friendly negotiation. It is only when the recommendations of the Council of the League have been accepted and incorporated by the boundary commissions that the precise limits of Hungary will be known. (For the status of the question as of June, 1922, see *Monthly Summary of the League of Nations*, Vol. 2, No. 6; and for a detailed map of the Burgenland area with boundaries in accordance with the plebiscite held under the terms of the Protocol of Venice, see *Kartographische und Schulgeographische Zeitschrift* Vol. 9 and 10, 1921, p. 136.)

## AFRICA

**Boundaries of the Spanish Sahara and the Ifni Enclave.** The narrow belt of ocean between the Canary Islands and the African mainland is one of the world's rich fishing grounds, though only a small part of the potential wealth is realized today. A fleet operates from the Canaries, and fish are dried and salted on the mainland and carried to market in Teneriffe and Grand Canary. The industry, limited as it is, constitutes Spain's chief modern interest in the Saharan coast where lies her possession of Rio de Oro and the near-by Ifni enclave in French Morocco. Spain's historical claims over these territories go back to the fourteenth century when the Canaries and the adjacent coast across the "Mar Pequeña" were incorporated in the Crown of Castile. The chief subsequent event on the mainland was the erection of the fort of Santa Cruz de Mar Pequeña by Diego de Herrera in 1476. Thereafter interest lapsed. Claims of possession were revived in 1860 when under treaty made with the Sultan of Morocco at Tetuán Spain was granted "in perpetuity sufficient territory for a fishing station on the coast of the ocean by Santa Cruz de Mar Pequeña as she had there of old" (Jerónimo Becker y González: Tratados, convenios y acuerdos referentes á Marruecos y la Guinea Española, Liga Africanista Española, Madrid, 1918). The Shereefian Empire, however, had no control over the tribes and was itself in a precarious political situation, and Spain was unable to take possession. In 1878 a Hispanic-Moroccan commission was appointed to define the territory and began work by instituting a search for the lost site of Santa Cruz de Mar Pequeña (García Pérez: Santa Cruz de Mar Pequeña y Sahara occidental, *Revista Gen. de Marina*, Vol. 45, 1922, pp. 435–455, Madrid). The coast was examined from Agadir to Puerto Cansada near Cape Juby, which latter has been generally identified with Diego de Herrera's fort. The Spanish commissioners, however, favored Ifni; and this point was eventually accepted. The Franco-Spanish conventions of 1904 and 1912 settled the limits of the territory, giving it an area of nearly 1,000 square miles.

The middle of the last century also saw a certain manifestation of Spanish commercial interest on the Saharan territory bordering the coast, and early in 1885 Spain communicated to the powers her intention to establish a protectorate over the region from Cape Blanco to Cape Bogador. The following year by treaty with Arab chiefs (Treaty of Ijil) she acquired a sphere over the western Sahara stated to cover some 270,000 square miles. But here she came into conflict with France pushing northward from the Senegal. The convention of 1900 settled the common boundary of French and Spanish possessions as far north as the latitude of Cape Bogador (26°), curtailing the Spanish claims and awarding to France the valuable salt beds of Ijil. This treaty made provision for free export of native salt, mutual fishing rights in the Cape Blanco peninsula region, and for French right of preëmption over the Spanish possession.

The convention of 1904 defined the sphere of influence from 26° to the parallel 27° 40′ accepted as the southern limit of Morocco, and also a sphere in southern Morocco to and beyond the Draa. The Spanish rights west of the line were confirmed by the convention of 1912 with the exception of the territory beyond the Draa, which was made the southern boundary of Morocco. Spanish Sahara was thus cut off from Ifni. While thus settled in general terms the eastern frontier of Spanish Sahara has never been defined. All this time France had continued her policy of penetration and pacification, her aim being to establish connection between her west and north African domains. As the "corridor" of Rio de

Oro is not available, connection must be made across a stretch of difficult country, the "great desert" between the Adrar section of Mauretania, brought under control in 1913, and Algeria. Conjunction between the camel corps of these two areas has been recently reported ("La liaison de l'Afrique occidentale française avec l'Algerie," *Renseign. Colon.* (*Suppl. à l'Afrique Française*, November, 1921). The several Trans-Saharan railway projects recently brought forward in France include one across Mauretania (Général Calmel: Le Transmauritanien, Paris, 1921) which would call for certain boundary modifications. Meanwhile the Spanish domain has remained practically undeveloped, and authority over the interior is very imperfect. Most of the population is nomadic and moves to and fro across the frontier, and France complains of raids proceeding from Spanish territory. A French view of the situation is presented by Étienne Richet in his book "La Mauritianie" (Paris, 1920) wherein the Spanish colony is described as limited to "a simple fishing station." The Canary islanders have transactions at various points of the coast, but the only Spanish settlement is Villa Cisneros, a "citadel fortress," so little connected with the hinterland that even the water supply is brought monthly from the Canary Islands.

**The Population of Southern Rhodesia.** It appears certain that the British South Africa Company's rule over Southern Rhodesia must give way to either responsible government or union with South Africa. In view of the pending political change the 1921 census of white population is of special interest (*The African World*, June 24, 1922, p. 327). That the country has not yet emerged from the pioneer stage is shown by the nature of the last decennial increase—42 per cent (as compared with Great Britain 4.7; South Africa 19.2; Canada 20.2, Australia 21.8) of which 17.7 per cent represents natural increase. Yet a trend towards the demographic conditions of a settled population is apparent. Thus, while the percentage of males was 66 in 1911, it is now 56; and, where 64 per cent of the male population of 1911 was between the ages of 20 and 44, it is now 43. The origin of the population is also of interest. In 1911 49 per cent came from Europe, 46 per cent from Africa; in 1921 the respective percentages were 36 and 60.

The total white population of 33,620 (incorrectly given as 36,000 in *The African World*) is, however, very small by the side of the Bantus, estimated to number nearly 800,000. This great native population constitutes one of the serious problems before any new administration ("The Rhodesian Question," *Round Table*, December, 1921). It would prove a heavy burden for a self-governing state and no light matter for the Union of South Africa, which, as the President of the South African Association for the Advancement of Science for 1921 has pointed out, is "a country excelling in sociological problems, racial and interracial, national and international. No other country in the world has so many distinct races and nations settled within its borders, and at such diverse stages of social evolution" (J. E. Duerden: Social Anthropology in South Africa: Problems of Race and Nationality, *South African Journ. of Sci.*, December, 1921). Preliminary figures for the 1921 census place the white population of the Union at about a million and the colored (chiefly Bantu) at nearly five and a half millions.

## ASIA

**The Agriculture of the Ifugao.** In a review of A. L. Kroeber's "Peoples of the Philippines" (*Geogr. Rev.*, Vol. 11, 1921, pp. 462–463) reference was made to the interesting case of the Ifugao of Luzon whose agricultural skill is remarkable among primitive peoples. A detailed account of their agricultural practices in relation to tribal economy has recently been given by R. F. Barton ("Ifugao Economics," *Univ. of California Publs. in Amer. Archaeol. and Ethnol.*, Vol. 15, 1922, pp. 385–446).

The Ifugao dwell in the valleys and pockets of the rugged slopes in the northeastern part of the Cordillera Central. Not only are they separated from centers of civilization by several days' troublesome journey, but even among themselves valley has had little relation with valley save through war and blood feud. Economically they are almost self-sufficient. An analysis of their food sources shows only .024 parts from importation; agriculture provides .84 parts, wild foods .094, and animal culture .042 parts. The food staples are camotes (sweet potatoes) and rice. Camotes require less cultivation, for they do not require irrigation nor do they require a fertile soil. But, though they constitute the larger proportion of the food supply, they are not valued as is rice. His rice crop is the measure of a man's social status in Ifugaoland. It used to form his currency. His religion centers

around it. To obtain good weather for crops a great number of feasts are held at which pigs, chickens, and other animals are sacrificed. To provide these furnishes the chief economic motive. The varied and uncertain weather does indeed call for special intervention. Compared with other parts of the islands there is little sunshine. The annual rainfall is heavy, 100 to 125 inches. The rice-growing period here, February to June, is what in most other provinces is the dry season. The nearest approach to a dry season is during March and April when the rice fields sometimes suffer. Rice is grown on the irrigated terraces which sometimes climb the hillsides from elevations of 2,500 to 5,000 feet. The altitudinal range over which rice is grown leads to a certain mobility of labor, the workers moving from lower to successively higher fields for planting and harvest. Retaining walls may be over 20 feet high for fields less than 11 feet wide. Careful spade cultivation and careful selection of seed lead to the production of crops of excellent quality. The rice grains of Ifugao are said to be largest to be found anywhere.

## AUSTRALASIA AND OCEANIA

**Glacial Erosion in New Zealand.** In a recent bulletin of the New Zealand Geological Survey (Geology and Mine Resources of Western Southland, *Bull. 23*, 1921) an explanation of the great fiords of the southwestern coast of South Island is given by James Park. The mountain belt of South Island consists of uplifted and dislocated fault blocks, the surface of which—a peneplain surmounted by subdued mountains—is much modified by normal and glacial erosion. The fiords are regarded as due to glacial enlargement and deepening along valleys of normal erosion guided by faults. "The rounded and flowing contours of the mountains, the U-shaped valleys, cirques, truncated spurs, hanging valleys, mountain tarns, and rock basins are evidence of intense Pleistocene ice erosion. In the molding and modifying of the land the ice has evidently removed an immense amount of material," yet in the fiords "there is a conspicuous absence of ice-carried débris." Quotation is made from a report by Hector in 1863, showing an early recognition of glacial erosion in this region: "The lateral valleys join the main one at various elevations but are all sharply cut off by the precipitous wall of the [Milford] Sound, the erosion of which was no doubt continued by a great central glacier long after the subordinate and tributary glaciers had ceased to exist." This approaches but does not quite reach the modern understanding of the hanging-valley problem.

Significant details concerning the incomplete glacial erosion of overdeepened troughs in the alpine region of southern New Zealand are given by R. Speight of the Canterbury Museum, Christchurch, N. Z., in an essay on "The Modification of Spur-Ends by Glaciation" (*Trans. and Proc. New Zealand Inst.*, Vol. 53, 1921, pp. 47–53). The preglacial form of the mountains was sub-mature; "valleys had been cut in an elevated area, and a well developed stream-system had been established with long spurs trailing down into the main valleys." As one enters the valleys, the spurs outside of the glaciated area still preserve long trailing forms; a short distance inside the glaciated area the spurs are moderately notched; farther in, the notches increase in depth and divide the spurs into a series of rounded knobs; farther still, the spurs are more or less completely removed, the knobs being greatly scoured away where they still survive and the spur ends being strongly truncated.

W. M. DAVIS

## POLAR REGIONS

**An Expedition to Jan Mayen Island.** The Island of Jan Mayen, lying between Iceland and Spitsbergen, shares the fate common to remote islands of discovery and rediscovery, legendary and authentic. The first discovery has been attributed to the much-traveled Saint Brendan, a thesis recently supported by Dr. Charcot, of the *Pourquoi Pas*, who visited Jan Mayen in 1902 and 1912 and 1913 ("Au sujet de l'île de Jean Mayen," *Comptes Rendus de l'Acad. des Sci.* [*de Paris*], Vol. 172, 1921, March 14, pp. 669–670). Doubtless the island was known to the early Norse voyagers whether or not it is the "Svalbard" of the Icelandic sagas. Its rediscovery dates to the time when the northern waters acquired importance as a whaling ground in the early seventeenth century. English and Dutch, rivals on the fishing grounds, were rivals for the discovery. Hudson has been accredited, but it appears now that the honor goes to the Dutchman Jan Jacobsz May for his voyage of 1614, though he was close followed by the Englishman Robert Fotherby (1615). While

the fisheries maintained their importance Jan Mayen with Spitsbergen was a scene of activity; since then it has been visited by occasional whalers and sealers and, during the last century, has attracted a certain amount of scientific attention. Most observers, however, have spent only a short time on the island; and some parties, indeed, failed to land by reason of the ice or weather conditions along its inhospitable shores. Such was the case with the Stackhouse Expedition of 1911 (*Bull. Amer. Geogr. Soc.*, Vol. 43, 1911, pp. 881–890). Our chief source of information has been the work of the Austrian party that maintained there one of the International Circumpolar stations in 1882–1883.

Last year a successful expedition to Jan Mayen was conducted by Mr. J. L. Chaworth-Musters of Cambridge University. Mr. J. M. Wordie, who accompanied the expedition as geologist, gives an account of its operations in the March number of the *Geographical Journal*. The prime objects were to make natural history collections supplementary to those of the Austrian party and to climb Beerenberg.

Jan Mayen is a volcanic island of comparatively recent origin. The mountains of the southwestern end are moderately subdued. At the northeastern end is the beautiful cone of Beerenberg, with the exception of certain nunataks of Greenland the loftiest mountain within the Arctic. The formation of Beerenberg is among the last events in the physiographic history of the island, though it has not been active in historic time. Ascent of the mountain was accomplished and its height established, by aneroid, as 8,090 feet against the theodolite measurement of 8,350 feet by the Austrian party. The diameter of the crater was estimated at half a mile, and the depth as 500 to 800 feet. On the northern side the crater is breached by a gap through which emerges the Weyprecht glacier in a "series of wonderful falls." The mountain is almost completely covered with snow and ice, and the glacial system is of special interest. A summary statement regarding it is given by Professor Mercanton, the eminent Swiss glaciologist who accompanied the expedition (*Comptes Rendus*, Vol. 174, 1922, June 6, pp. 1479–1481). The entire system appears to be in retreat; icebergs are no longer calved from those glaciers that reach the sea, despite their crevassed fronts; and some lobes no longer reach the sea.

Jan Mayen is of no direct commercial interest today; indirectly, however, it has significance as a weather forecasting station. The importance of the island in this respect was pointed out by the International Aerological Polar Commission meeting at Copenhagen in 1914 and subsequently by the Norwegian Geophysical Commission ("Various Papers on the Projected Co-operation with Roald Amundsen's North Polar Expedition," *Geofysiske Publikationer*, Vol. 1, 1920, No. 4, Christiania). Jan Mayen lies in the Icelandic low at a quarter whence proceed the frequent northwest gales that do much damage to Norwegian coastwise shipping. The Norwegian government decided to support the experiment urged by Norwegian scientists. Mr. Chaworth-Musters' expedition was accommodated on the vessel carrying a party under Engineer Ekerold to erect a wireless weather station. The station, which has now been in operation for nearly a year, has proved a notable success (note on Jan Mayen in *Geographical Journal*, June, 1922, p. 475) and will be continued.

**The Vegetation of Western Greenland.** A summary of our present knowledge of the vegetation of western Greenland is given by R. E. Holttum in the May number of the (British) *Journal of Ecology*. The strip of ice-free land on the west of Greenland is characterized by an oceanic climate. The mean annual temperature ranges from 1° C. at the southern tip to −8° C. at Upernivik, latitude 73° N., the most northerly Danish colony: July temperatures from 10° C. to 5° C. respectively. Precipitation diminishes northward from 50 inches at the southern extremity to 8 inches at Disko and 9 inches at Upernivik. Summers are cool and damp with sea fog common at sea level, conditions being uniform over a long stretch of coast. The July isotherm of 10° C. is approximately coincident with the northern tree limit; hence tree growth can be looked for only in the extreme south. In Tasermuit Fiord (latitude 60° N.) birches grow to the exceptional height of 20 feet. As far north as the 62nd parallel the climax vegetation appears to be a birch-willow scrub. The birch (*Betula odorata*) is usually very thick but rarely reaches a height of 16 feet; the willow scrub (*Salix glauca*), which occupies the moister and less sunny places, may attain a height of 2½ feet but normally is not half that. Heath and grassland are also extensive.

North of latitude 62° N. heath is the dominant formation. It flourishes to considerable altitudes, on Disko Island, for instance, to above 2,000 feet. It is composed essentially of low woody plants of which the most important are the so-called Arctic heath (*Cassiope tetragona*) and the curlewberry (*Empetrum nigrum*). Where the climatic conditions are

less favorable heath gives way to an open formation, the fell-field of isolated stunted flowering plants with mosses and lichens. This is the characteristic vegetation of the nunataks and the extreme north (compare a popular account by W. Elmer Ekblaw: The Plant Life of Northwest Greenland, *Natural History*, Vol. 19, 1919, pp. 272–291, and the appendix on "Flora and Fauna on the North Coast of Greenland" in Rasmussen's "Greenland by the Polar Sea," reviewed in this number of the *Geogr. Rev.*). In favorable sites where there is an adequate snow cover in winter and protection from cold dry winds, as along sides of streams, willow scrub or a herbaceous vegetation may be found. Moss bogs occur on wet undrained soils, and there are special edaphic formations of salt marsh along the shore and a luxuriant vegetation round the settlements ancient and modern.

**The Northernmost Mountain Range.** A partial report on the Second Thule Expedition of 1916–1918 by Lauge Koch gives a good account of the structure of northwestern Greenland ("Stratigraphy of Northwest Greenland," *Meddel. fra Dansk Geol. Forening*, Vol. 5, 1920, No. 17). It appears that the greater part of the ice-covered area consists, judging by exposures along the coast, of a rather even foundation of crystalline rocks overlaid by ancient horizontal strata; but that the northwest coast, from Cape Morris Jesup to Robeson Channel and across it into Grant and Grinnell Land, has the structure of an ancient mountain system of folded and greatly denuded strata, now cut across by many fiords and thus resolved into as many promontories from 1,000 to 2,000 meters high. It is the northernmost mountain range in the world. Koch associates it with the ancient mountains of Scotland, Norway, and Spitsbergen.

W. M. DAVIS

## WORLD AS A WHOLE AND LARGER PARTS

**The Mapping of Latin America.** At the meeting of the British Association held at Hull early in September Mr. Alan G. Ogilvie read a paper on this subject before Section E (Geography). Mr. Ogilvie exhibited a new map in provisional form on which the present state of cartographic knowledge is represented. This map represents a part of the work carried out by the American Geographical Society in its Hispanic American division. It is hoped that its publication will be a real step in the direction of accuracy of expression. It is exceedingly difficult to determine from internal evidence the reliability of most of the existing maps of Latin American countries, and they are rarely accompanied by adequate indications of the materials from which they are compiled. This index map then, which is largely based on examination of original sources, will form a useful finger post, warning against the too easy acceptance of many maps which do not reveal their chief faults to those who have no means of checking their accuracy.

The process of mapping America south of the Río Grande del Norte has hitherto passed through three phases. The Colonial period from the discovery down almost to the birth of the independent nations was marked by much exploration and approximate mapping of the main features. The second phase corresponds to the explorations of eminent European naturalists led by Alexander von Humboldt whose interests were wide, but with whom the improvement in cartography was but one of their aims. The third phase has been marked by the operations of an ever increasing number of explorers whose main object has been the provision of more accurate maps.

At the present time the most reliable surveys in different regions have been carried out from several different motives. Thus, many long and important traverses and some areal surveys have been made by men—mostly Europeans—with a passion for exploration. The governments of mercantile states, primarily Great Britain and France, have accurately charted the coasts. Boundary disputes involving political and strategic questions have occasioned several of the most extensive and accurate surveys hitherto carried out in South America. But more and more it is the economic development of the continent which calls for accurate mapping, and in the future we may expect that survey by scientific methods will precede not only the building of railroads and opening of mines but the settlement of agricultural and even pastoral land. As boundaries become settled, and causes for war are removed, it will be the economic development of the various countries which will maintain the geodetic and topographic services of states which already possess them, such as Mexico, Argentina, and Chile, and will lead to the creation of such services in the states where they now are absent. Amongst the economic purposes which have already led to the mapping of important areas of Latin America the following may be specially mentioned:

railway surveys, especially in Mexico, Chile, Argentina, and eastern Brazil; in Peru, river surveys with the aim of establishing navigational outlets to the Amazon, and areal surveys of river basins in the Maritime Andes with a view to irrigating parts of the coastal deserts; surveys of possible oil territories in Mexico, Central America, Colombia, Venezuela, Peru, and on the eastern fringe of the Andes in Bolivia and Argentina; while our map knowledge of Central America rests mainly upon the surveys preceding the selection of routes for the interoceanic canal, and for an intercontinental railroad, supplemented by the data of the fruit-growing companies and the route traverses of a few veteran explorers. In Brazil the economic status of the various states is to some extent reflected in the state of their maps—São Paulo alone being largely covered by systematic survey. But the need of communications between the two contrasted divisions of the Republic has led to important explorations about the southern tributaries of the Amazon and their sources.

An interesting—if obvious—fact is revealed by the map referred to at the beginning of this note; namely that nearly all the lands in which areas of any size as opposed to mere routes have been surveyed lie in the unforested regions of South America or in regions of open woodland. The great Amazonian forest is today marked on the map by a relatively small number of known arteries—its rivers; and few of these have yet been surveyed by accurate methods.

**The Air Route from Cairo to Baghdad.** Extensive use of aircraft in the Near East during the war has been followed by the establishment of a regular air connection between strategic points in this section of the British Empire's most important line of communications, the road to India. The significance of the Cairo-to-Baghdad air service is illustrated in the saving of time on the mails. Ordinarily a letter from London to Baghdad travels via the Suez Canal, the Red Sea, Bombay, Karachi, the Persian Gulf, and Basra—taking between five and six weeks. The establishment of an airplane service between Cairo and Baghdad has reduced this to a minimum time of 9 days.

Two interesting descriptions of the route have recently appeared, "Some Notes on Aeroplanes, with Special Reference to the Air Route from Cairo to Bagdad," by Air-Commodore H. R. M. Brooke-Popham (*Journ. Central Asian Soc.*, Vol. 9, 1922, pp. 127–146, London) and "By Air to Baghdad," by H. T. Montague Bell (*The Near East*, No. 575, Vol. 21, 1922, May 18, pp. 669–674). From Cairo, which seems destined to be one of the world's chief centers of aerial transport, the route proceeds northeast, crossing the Suez Canal at Kantara and passing over Jerusalem and the "inhospitable" Judean hills and the Jordan about its entry into the Dead Sea. Amman, on the Hejaz railway and capital of Trans-Jordania, is an important way station beyond which the route enters on the 500-mile stretch of the Arabian desert. The undulating surface of the desert is over 2,000, in some places over 3,000, feet above sea level and for the first hundred and more miles shows bare lava outcrops alternating with yellow mud flats, "level as a billiard table," covered with water in the rainy season. Traces of an ancient civilization are seen in the lava country. Beyond is a poor steppe country grazed over by nomad Arabs after the rainy season (winter and early spring) and even in summer the theater of occasional raids. Halfway between Amman and Baghdad the two wells known as El Jid form one of the two or three permanent watering places in the desert route.

It was necessary to mark the air route over the comparatively featureless desert country, and this has been accomplished in an ingenious fashion by passing a number of heavy motor lorries over the same track. The track can easily be picked out at elevations of 3,000 to 8,000 feet and need be renewed but once a year. The first half of the course from Amman to El Jid was executed and mapped by Dr. Ball, of the Egyptian Survey; the second half by the Royal Air Force. The marking of the track in June, 1921, was the first known European crossing of this portion of the Arabian desert. Northward lies the well-known caravan route through Damascus (compare Sir Ross Smith's flight over Damascus, in "From London to Australia by Aëroplane," *Natl. Geogr. Mag.*, Vol. 39, 1921, pp. 229–339); but its course is not available to military planes because it crosses into the French sphere.

Meteorological conditions encountered in flying across the desert offer points of interest. The journey east-bound is normally accomplished in less time than west-bound, for at an elevation of 1,000 feet above the surface the westerly wind is apparently permanent. Near the surface sudden changes of wind are characteristic. The worst meteorological trouble seems to be the dust storms, which are not only of frequent occurrence in the warmer months but extend upwards to great elevations — according to Air-Commodore Brooke-

Popham, to heights of 12,000 feet. The formation of dust in the neighborhood of Samara on the Tigris is described in a recent memoir by C. W. B. Normand ("On Dust-Raising Winds," *Memoirs Indian Meteorol. Dept.*, Vol. 22, Part VII, 1921, Calcutta).

## HUMAN GEOGRAPHY

**The Cold of the Tropics in Relation to Health.** The same "passion for simplicity" that fosters the idea of an Arctic climate always and everywhere intensely cold (V. Stefansson: Some Erroneous Ideas of Arctic Geography, *Geogr. Rev.*, Vol. 12, 1922, pp. 264–277) accepts the idea of tropical climate as "unhealthy." This view is challenged by F. L. Hoffman in a short article "Climate and Health in the South American Tropics," in the January number of the *Monthly Weather Review*. Mr. Hoffman, whose statistical work in relation to health and mortality is well known, has recently spent some time in northern South America. He sees no reason "why a so-called tropical climate should be *per se* an unhealthy one. Tropical heat, of course, gives rise to tropical parasitical life with its resulting evil pathogenic effects upon the human organism. But such diseases as result indirectly from tropical heat and moisture can now be effectively guarded against by the intelligent observance of ordinary rules of living." The chief deleterious effect of the climate is cold — the cool, often "distressingly" cool nights. "The chief causes of ill health and premature death in northern South America are not tropical diseases but respiratory and rheumatic affections, which prevail to an enormous extent among the native population. The sensible temperature at night is at times extremely trying and guarded against only by an abundance of covering, which is usually wanting in the case of the native population. Houses are poorly constructed, and the draughts during the night chill the body to a point where disease resistance reaches its lowest ebb. Coughs and colds are of practically universal occurrence, and no precautions are employed on the part of the natives, who are improperly fed, improperly clothed, and improperly housed. The resulting high mortality is not chargeable to the climate, but to apathy and indifference and colossal ignorance."

In Mr. Hoffman's experience the most trying period is between 2 and 3 in the morning when the temperature may be 30° or more lower than in the daytime. Actual instrumental records are scant from the region in question, but such as exist are amply illustrative. For instance at Santo Anato in the Urubamba valley of Peru, a little below 2,000 feet in altitude, in August a daytime maximum of 92° was followed by a minimum of 54° (Isaiah Bowman: The Andes of Southern Peru, p. 178). Other examples are quoted by S. S. Visher in an article "Variability and Uniformity in the Tropics" (*Scientific Monthly*, Vol. 15, 1922, pp. 23–35). On the dry western sides of the Fiji Islands temperatures below 40° have been recorded near latitude 16° close to sea level. Besides the regular and marked cooling of the tropical night the uniformity of tropical temperatures may be broken by irregular "cold spells." A striking illustration is the characteristic occurrence of westerly and northwesterly gales on the Venezuelan coast from December to mid-March which last several days and bring temperatures of 45° or even less (*Meterol. Mag.*, Vol. 56, 1921, p. 42).

Tropical variations in wind, rainfall, and storminess are also discussed by Mr. Visher with the object of correcting a general overemphasis on tropical uniformity arising from conventional statements based on averages.

**Aerial Navigation in Its International Aspects.** The Convention for the Regulation of Aerial Navigation held at Paris in October, 1919 (*Treaty Series No. 2, Cmd. 1609*, London, 1922) marks a stage in the history of international communications. The convention is adhered to by 27 Powers. Its chief result is provision for the institution of the International Commission for Air Navigation. In addition to its executive function the commission is charged with matters of specific geographical interest; to collect meteorological and other information of interest to international air navigation and to ensure the publication of maps for air navigation in accordance with standard requirements.

The maps embrace two types, general and local, the index scheme being based on that adopted for the international millionth map, and units of measurement, colors, symbols, and arrangements are to conform with the millionth map as far as practicable. The general maps are to be drawn on the Mercator projection and to a scale of 1 degree of longitude equals 3 centimeters. Each will bear the heading "Carte générale aéronautique internationale," a translation of this heading in the language of the country publishing the map,

and an appropriate geographical name. It will show at least the following data: principal physical features and geographical names; wirelesss stations; marine lighthouses (height and range at sea level, color and character of the light); national frontiers; prohibited areas; principal air routes; lines of equal magnetic variation; south polar distance; latitude, old and new notation of longitude (see local maps), with an outer margin containing letters and numbers referring to the index of the millionth map; legend of symbols in English or French and in the language of the country publishing the maps; publisher's name and date of publication and of successive editions.

The local maps are to be drawn to a scale of 1:200,000 or, in the case of sparsely inhabited countries, 1:500,000 or 1:1,000,000 as may be appropriate. In addition to the usual notation they will show a new grid reckoning which, with regard to latitude, commences at the South Pole as zero and increases northward by degrees and minutes to 180° at the North Pole and, with regard to longitude, commences with the antimeridian of Greenwich as zero and runs eastward by degrees and minutes to 360°. The local maps are to comprise one degree of latitude and one degree of longitude. The local sheets are to show as far as data are available the following: twenty-minute projection grid; roads divided into two classes according to their relative visibility from the air; railways of all kinds; cities and towns in outline and the plan of the principal public roads crossing them (villages similarly if practicable, otherwise their positions indicated); principal features of the surface water system; woodlands and other areas unsuitable for landing; aerodromes; hangars for airships; plants for balloon inflation; permanent landing places on ground and water; aeronautical ground marks (beacons and fixed navigational lights); marine lighthouses (height, range at sea level, color and character of the light); wireless stations; meteorological stations; overhead electric power lines; remarkable objects; national frontiers; the frontier crossings for customs purposes; prohibited areas; principal air routes; names of important bodies of water; towns and important villages; the topographical relief by shading and figures indicating heights, the most important of which to be surrounded by an oval ring.

As the ordinary topographic mapping is inadequate for aeronautical maps, it is suggested that steps be taken to survey from the air areas along the most important international routes.

Three classes of meteorological information are to be furnished: (1) statistical, to indicate the degree of safety and convenience of routes and aerodromes; (2) current; and (3) forecasts for various periods and for routes. The forms for reports and codes for transmission are given.

## GEOGRAPHICAL NEWS

### PERSONAL

PROFESSOR ALBERT PERRY BRIGHAM of Colgate University gave a course of lectures on America before the Oxford University School of Geography at its summer meeting. The subjects were: The American Domain, Distribution and Racial Character of the Population, Education, and Social and Political Ideas.

### OBITUARY

H. S. H. ALBERT I, PRINCE OF MONACO. Oceanography suffers a loss by the death in Paris on June 26 of the Prince of Monaco. The Prince leaves a permanent memorial in the form of three well-equipped scientific institutions, the Musée Océanographique in Monaco, the Institut Océanographique in Paris, and there also the Institut de Paléontologie Humaine—the last a testimonial to the benefactor's personal interest in prehistoric archeology as well as in all things oceanographical. The museum collections, especially that of the Cetaceae, testify to the Prince's prowess as hunter and naturalist; the exhibits of apparatus, many devised by him, to his practical knowledge as sailor and mechanical engineer; the splendid series of publications emanating from the Press at Monaco, to the wide range of oceanographic interests that he has fostered. The publications render available the results of the many annual cruises of the Prince's yachts, in the northern Atlantic and Mediterranean, and are planned to serve similarly for the work of the recently founded Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée, of which the Prince was president.

The phase of the Prince's work that has perhaps attracted the widest attention is that on

the currents of the northern Atlantic: one of his last published contributions to science was a study of the probable drift of mines in these waters based on the course of floats dispersed from the *Hirondelle* in 1885–1888 (see the note in the *Geogr. Rev.*, Vol. 10, 1920, pp. 419–420). His work as a whole has been summarized in the words of the inscription on the Cullum Geographical Medal of the American Geographical Society awarded the Prince in 1921. "By intensive exploration and by research and publications of the highest order he has advanced the science of oceanography and extended man's knowledge of the sea and its resources."

ROLLIN D. SALISBURY. In the death of Professor Salisbury on August 15 at the age of 64 a severe loss is sustained by the departments of geology and geography of the University of Chicago. Professor Salisbury had been associated with the University since 1892. He was dean of the Ogden School of Science since 1894, head of the department of geography from 1903 to 1919, and since then head of the department of geology. Professor Salisbury's main interests have been in physical geography. His original work has been done largely in glacial geology, but he was first and foremost a teacher, and his most valuable contributions are the many textbooks of which he was sole or joint author. These include "Physiography," of which the first edition was published in 1907, the third in 1919; with Thomas C. Chamberlain, "Geology," 2 vols., 1904, 1906; "The Interpretation of Topographic Maps," *U. S. Geol. Survey, Professional Paper No. 60*, 1908, written in collaboration with Wallace W. Atwood, which has proved a valuable adjunct in physiography teaching; with H. H. Barrows and W. S. Tower, "Elements of Geography" (1912). Professor Salisbury was joint editor of the *Journal of Geology*. He was a member of the Association of American Geographers and acted as its president in 1919.

MR. LEVI HOLBROOK, Councilor of the Society, died on July 26, aged 86 years. He became a Fellow of the Society on December 17, 1872, and a Life Fellow on May 14, 1889. He was elected to the Council in January, 1888, and served as the Secretary of the Council from February 1, 1890, to February 15, 1912. For many years he was Chairman of the Lecture Committee and from time to time served on various special committees appointed by the President.

# GEOGRAPHICAL REVIEWS

## Exploration in Central Asia

Aurel Stein. **Serindia: Detailed Report of Explorations in Central Asia and Westernmost China.** Vol. 1, xxxix and 547 pp.; ills., bibliogr.; Vol. 2, viii and pp. 549–1088; ills.; Vol. 3, xi and pp. 1089–1580; maps, diagrs., ills., index; Vol. 4, x pp. and 175 pls. 1 portfolio (Vol. 5) with 94 maps. The Clarendon Press, Oxford, 1921. 13½ x 10½ inches.

The most important work upon Central Asia that has appeared in many a day is "Serindia," in which Sir Aurel Stein gives us the long and eagerly awaited report of his explorations, mainly archeological but also to a very considerable extent geographical and ethnological, during his second Central Asian expedition, in 1906–1908. It embraces the full record of two and a half years of arduous but most profitable labor in that region to which French scholars refer as Sérinde, between the Pamirs on the west and the Pacific watershed on the east, where the Indian and Chinese cultures have met. The particular period to the study of which the author mainly devoted himself was that relatively brief but intensely interesting one, covering in all but a few centuries, when the Buddhist faith, modified to a certain extent by transmission through the hands of Iranian intermediaries, was being carried across the Central Asiatic regions to China, Korea, and Japan.

The work carries us step by step along the author's route from the time he left the Peshawar border, through his various stages past the southern rim of the Taklamakan to northwestern China proper, and then back by way of the old northern route. For the personal incidents of travel Sir Aurel refers us to his "Ruins of Desert Cathay," which appeared in 1912, and which those not already familiar with it would do well to read in conjunction with "Serindia" in order to get a full conception of the arduous character of the expedition and the hardships and dangers encountered in its course.

The earlier portion of the route by which Sir Aurel proceeded from India to the scene of his labors is of interest for its association with Alexander's career. In this connection the author makes numerous interesting comments; but he holds out little hope (pp. 2 and 4) of the certain identification of many of the more important sites mentioned by historians, such, for example, as Massaga, or the still more famous Aornos. The Indian character of the population found by the Macedonians in the Kabul valley is pointed out—an indication of a very definite shifting toward the Indus, during the past two thousand years, of the linguistic and cultural, if not the actual ethnic, boundary between India and Iran. Perhaps in some way connected with this has been a distinct recession of the Iranian frontier on the east and northeast. One result of the Central Asiatic explorations of the past few years—a result to which Sir Aurel has himself contributed in no small measure—has been to demonstrate the former much greater extension eastward of the Aryan-speaking peoples, even as far as the borders of China proper. It seems to be demonstrated that as far eastward as Khotan and even farther, toward the Tun-huang oasis, forms of Iranian were spoken as late as the eighth century, not dying out completely indeed until about the end of the tenth. What the Iranians have won on the southeast they have lost, and more than lost, in the direction of Central Asia.

The second and third sections of this first chapter give a sketch of that Chinese contact with northwestern India for our knowledge of which we are indebted to the accounts of the travels of Buddhist monks like Fa-hsien, early in the fifth century, and the better-known Hsüan-tsang, in the seventh. Readily comprehensible is Sir Aurel's enthusiasm for the self-devotion and fortitude displayed by these simple Chinese monks in their journeys across the Central Asiatic deserts and mountains to the homeland of their faith; for nowhere and at no time have men displayed greater readiness to undergo privation and danger in their search for the truth.

Chapter 2 offers us (pp. 52 ff.) an account of the eighth-century Chinese conquest of Yasin and Gilgit, a feat which included the crossing of the Pamirs and the Hindukush by an army of 10,000 men and which reflected all the greater credit upon their leader, General Kao Hsien-

chih (his name deserves to be remembered) because of the poor quality and low morale of his troops. The Chinese have more than once shown in the conduct of their military operations among the great mountain masses of Central Asia a genius which makes the crossing of the Alps look like child's play by comparison; witness their invasion of Nepal late in the eighteenth century, when after advancing over two thousand miles from their base, by a road which led across the inhospitable tableland of Tibet, they conquered on its own soil one of the finest fighting nations in India.

In the ninth chapter occur important historical notices on "Lop, Shan-shan, and Lou-lan" (pp. 318 ff.), while the next, entitled "Through the Lop Desert" (pp. 346 ff.) is of especial interest from the geographical point of view. It is worth while noting that in one of the sections of the latter chapter, "Across an Eroded Ancient Delta," as well as here and there elsewhere in the book, one finds recorded the picking up, on wind-eroded surfaces, of stone implements, some of them Neolithic and others possibly, although by no means certainly, Paleolithic. The prehistoric period in Central Asia, less spectacular in the character of its remains than the Buddhist epoch but of vastly greater importance to a proper understanding of the culture development not only of the region itself but also of those adjacent areas between which it has always played the part of a bridge, is one which calls most urgently for investigation. Only thus, for instance, can we hope ever to reach any solution of the beginnings of Chinese civilization.

Chapters 14–20, forming the first seven of the second volume, deal mainly with geographical matters and give us an account of the author's journey from the Lop region eastward to the Tun-huang oasis. These portions of the work tell us much that is entirely new regarding the western end of that old Chinese system of frontier defense which we call comprehensively the "Great Wall." Sir Aurel points out (p. 552) the former importance of Tun-huang as the westernmost outpost of China and the base for her earliest Central Asian operations. The third section of Chapter 14 contains some interesting remarks upon Marco Polo's journey through these same regions, while in Chapter 20 is described the identification of the site of the famous Yü-mên, or "Jade Gate," once the chief frontier town hereabout and the outlet through which passed all traffic with the west by the ancient Lou-lan route, including the export trade in silk to Parthia and the Roman Orient, treated of in the fifth section of this same chapter.

The attainment of one of the main goals of the expedition, the "Caves of the Thousand Buddhas" (Ch'ien-fo-tung), lying a few miles southeast of Tun-huang, is graphically described in the twenty-first chapter, while in the one following, "Exploration of a Walled-up Hoard," is the account of one of the most extraordinary manuscript finds of modern times, in one of the artificial caves of this site. To quote the author's own words, "The sight disclosed within made my eyes open wide. Heaped up in closely packed layers, but without any order, there appeared in the dim light of the priest's flickering lamp a solid mass of manuscript bundles rising to a height of nearly 10 feet. They filled, as subsequent measurement showed, close on 500 cubic feet, the size of the small room or chapel being about 9 feet square and the area left clear within just sufficient for two people to stand in" (p. 808).

Volume 3, the last of the text, has to do with the return journey of Sir Aurel by the old north road, via Hami and Turfan, as far as Kucha, where he took a "short cut," as he calls it, across the Taklamakan desert to Khotan and thence to India and home.

The series of appendixes at the close of the text in this volume consists of essays by various authorities on different portions of the material gathered by Sir Aurel Stein on this expedition and covers no less than 145 pages. As with the text proper, their scope is far too broad to allow of more than a mere sampling of their contents. Appendix C, by T. A. Joyce (pp. 1351–1389) discusses the physical anthropology of Chinese Turkestan and the Pamirs. Following it is a description, by Sir Arthur Church, of specimens of mural painting and plaster from various sites, mainly Buddhist. Appendix E contains three essays by the late Raphael Petrucci, as well as a brief but illuminating sketch by Laurence Binyon (pp. 1428–1431) of the art of the Tun-huang paintings.

The fifty-nine excellent plans of sites, ruins, etc., with which this third volume concludes deserve the highest commendation both for the evident care with which they were drawn up in the field and for the way in which they are presented here.

Of the 345 half tones in the text, all are finely executed and truly illustrative in the best sense; the scenes among the great snow mountains in particular reflect rare credit on the photographer not only for his technical skill but for his artistic sense as well.

The fourth volume contains 175 excellent plates representing finds of every description. A considerable number are in color, the workmanship here being of the same high standard as all else about the book.

The final "volume" is in reality a portfolio of maps, most adequately arranged for convenience of reference. In addition to one general map and an index map (the latter a most useful feature), both on a scale of 1 : 3,000,000, there are ninety-four others on a scale of 1 : 253,440, or 1 inch = 4 miles; many of these are of no little importance geographically.

A most praiseworthy feature is the list of titles on the region under consideration, together with the abbreviations under which they are cited (pp. xxv–xxviii). No less to be commended are the detailed descriptions of finds, inserted in the text as additional sections appended to the chapters with which they have to do; in this way the text is relieved of much detail that would render it distinctly less readable, while at the same time this descriptive material is placed just where it is most convenient for reference. Finally, there is a most excellent index.

Among the many things for which "Serindia" deserves particular approbation is the care taken in the transcriptions of Chinese names. Sir Thomas Wade's system, as exemplified in Gile's Dictionary, is that employed; and, while most students will probably agree that it is far from being an ideal one, it is at least the one best known and most generally used and therefore to that extent the standard, so far as writers in English are concerned. The way in which the transcriptions are accompanied by the corresponding Chinese characters is also deserving of notice and, in so far as possible, of emulation.

It would be difficult to point out any particular in which "Serindia" falls short of being all that a report of this kind should be. Sir Aurel presents the results of his labors in straightforward, succinct fashion, without weaving any theories or engaging in polemics of any sort. He has, furthermore, the happy gift, whether he is writing a personal narrative or compiling a formal scientific report, of knowing how to be vivid and interesting as well as painstaking and accurate.

C. W. BISHOP

## ANCIENT CULTURAL RELATIONS BETWEEN CHINA AND IRAN

BERTHOLD LAUFER. **Sino-Iranica: Chinese Contributions to the History of Civilization in Ancient Iran, with Special Reference to the History of Cultivated Plants and Products.** iv and pp. 185–630; indexes. *Field Museum of Nat. Hist. Publ. 201* (*Anthropol. Ser., Vol. 15, No. 3*). Chicago, 1919.

As we all know, the success achieved by Dr. Laufer in the past two decades and more in throwing light upon Far Eastern culture development has placed him in the foremost rank among students in that field. His recent work, "Sino-Iranica," fully maintains the high standard of scholarship which he has set for himself, and for others as well, along those lines.

The object of the book, the author tells us (p. 207), is "to present . . . a synthetic and comprehensive picture of a great and unique plant-migration in the sense of a cultural movement, and simultaneously . . . to determine the Iranian stratum in the structure of Chinese civilization." In the pursuance of this aim no less than one hundred and thirty-five subjects are treated of. These are concerned mainly, as the subtitle informs us, with the diffusion of various cultivated plants. Such things, however, as Persian textiles and Iranian minerals, metals, and precious stones are also discussed; while a section is devoted to the titles employed by the Sassanian Government, and another to the cultural debt owed by the Persians to China.

In connection with his plant studies Dr. Laufer lays special emphasis upon the historical fact, so often ignored by later writers both native and foreign, that the great Chinese traveler, Chang K'ien, who first established a direct and conscious contact between his own land and western Asia, brought back with him two new plants and only two, viz., alfalfa and the vine (p. 190 and *passim*). The point is further made (pp. 220 ff.) that there can have been but one center for the origin of grape growing and that viticulture and wine making and the use of alfalfa as well were found by the Chinese among Aryan-speaking peoples and not at all among the Turks.

Another interesting and significant fact pointed out (p. 293) is that one of the fundamental differences between the Chinese and the Mediterranean civilizations was the use of hemp by

the former and of flax by the latter as the material for clothing. As Dr. Laufer says (p. 294), their failure to acquire flax in ancient times "is a clear index of the fact that the Chinese never were in direct contact with the Mediterranean culture-area, and that even such cultivated plants of this area as reached them were not transmitted from there directly, but solely through the medium of Iranians."

It is a trifle puzzling at first glance to see why the section on rice (pp. 372–373) should have been included, since it is unlikely that either of the two regions in question, China or Iran, received that food plant from the other. Nevertheless rice appears to have penetrated to Central Asian regions extremely early. The Chinese authorities cited on this point in "Sino-Iranica" carry us back to the second century B. C., while if the statement in the "Muh T'ien-tsŭ Chuen," or "Journeys of the Emperor Muh," can be believed, that ruler found a fine quality of rice growing in the west, apparently in the Tarim or Turfan regions, as far back as the tenth century B. C. Hence it seems not impossible that at least the easternmost of the Iranian-speaking peoples got their rice culture, some time during the prehistoric period, from the valley of the Hwang Ho instead of from that of the Indus or of the Euphrates.

It is interesting to note that Dr. Laufer now admits (p. 569) "some degree of probability in the old theory that the name 'China' should be traceable to that of the dynasty Ts'in." Those who have hitherto combated this hypothesis have done so mainly because they failed fully to grasp the importance of the rôle played by the principality of Ts'in (or Ch'in according to the more general pronunciation) long before her conquest of the rest of China late in the third century B.C. To say that "China" cannot be derived from "Ch'in" merely because the former name seems to have appeared in western lands in one form or another before the prince of Ch'in became emperor of China is wholly to overlook two cardinal facts: firstly, that from the eighth century B.C. onward Ch'in was in full control of the Central Asian gateway from China to the West; and secondly, that in the fourth century B.C. she also secured command of the Yünnan-India route by her conquest of eastern Szechwan and the upper Han valley. Thus it was wholly through Ch'in in those days, before the commencement of overseas intercourse between China and the West, that any knowledge of what we now call China proper could possibly reach the latter. Furthermore, in the fourth and third centuries B.C. Ch'in was one of the largest, most powerful, and best organized states not merely of eastern Asia but of the whole world. Hence it is not remarkable that the peoples of India, Persia, and lands farther to the west should have extended her name to the regions lying beyond her, whose products they received only through her and which she did actually in the latter half of the third century B.C. incorporate within her dominions.

Dr. Laufer rightly emphasizes (p. 186) the importance of the application of the laws of ancient Chinese phonology to the elucidation of Iranian tribal and place names and points out (p. 187) that the ancient Chinese scholars had developed "a rational method and a fixed system in reproducing words of foreign languages."

Undoubtedly well founded is the criticism of the prevalent system of transliterating Chinese words. Dr. Laufer might have said even more than he does in this regard; not only is it "clumsy and antiquated," but it is arbitrary and in many respects hopelessly incomprehensible to the lay reader without special instruction. Unfortunately it is too generally and firmly entrenched and represents too many vested interests to render likely its speedy replacement even by a system so consistent, so transparently simple, and so accurately phonetic, as that suggested on page 188. What is needed and what will be required before any real advance in this direction can be hoped for is a general and explicit agreement upon an improved system among students the world over. No man, even one of the standing in this field enjoyed by Dr. Laufer, can hope to do much singlehanded toward this end.

The primary usefulness of "Sino-Iranica" lies undoubtedly in the vast fund of information with which it provides us regarding a great variety of definite and specific Oriental culture objects and products. From this point of view it can scarcely be praised too highly. Yet it also performs another service, no less important because it is of a more general and less immediately striking kind. Most of us were taught at school that the Persian Empire was a vast, tyrannical, barbarian, "Asiatic" power whose function in the development of civilization was, like that of the Mongols or the Turks, destructive merely. Dr. Laufer, in this as in others of his writings, does much toward enabling us to correct such a view and to realize that in point of fact Persia in the days both of the

Achaemenides and of the Sassanians was a center of the world's very highest civilization, playing in the cultural development of all the lands about her a part whose importance we are only just beginning to understand.

C. W. BISHOP

## POLITICAL AND SOCIAL IMPRESSIONS OF THE FAR EAST

J. O. P. BLAND. **China, Japan, and Korea.** x and 327 pp.; ills., index. Charles Scribner's Sons, New York, 1921. $5.00. 9 x 6 inches.

Mr. Bland's former residence and practical experience in the Far East and his wide official acquaintance entitle him to serious hearing. His book is divided into two parts, the first being a political survey and the second a series of chapters entitled "Studies and Impressions." The political and social life of the people of the Far East is in many respects closely interwoven with the physical circumstances of the region, a point of view which was developed in a scholarly and convincing manner in the January number of the *Geographical Review* ("The Geographical Factor in the Development of Chinese Civilization," by Carl Whiting Bishop, *Geogr. Rev.*, Vol. 12, 1922, pp. 19–41). We find ample evidence of this throughout Mr. Bland's book, particularly in the portions that deal with the density of population and the fine shades of adjustment which may be observed as the population, particularly of China and Japan, steadily increases, making the food supply a more intense question and bringing into play modern political and social forces of deep importance.

The second half of Mr. Bland's book is most delightfully written. He is never a dull writer, but in the later chapters the style rises to a very high level of literary perfection without at any time losing the quality of restraint that bespeaks judgment and integrity. In the field of political geography there are few contributions but rather the reaffirmation of points of view and of facts made familiar through western writings on oriental policies and practices during the past ten years.

One marked effect of the overcrowding of China, in the view of Mr. Bland, is the widespread desire to better living conditions; and this desire has steadily molded the character of the Chinese people through many centuries. Thus there is perpetual striving to raise one's self above the common level. Men of ambition seek power in order that they may gather to themselves forces and revenues that free them from the bondage of the soil or the shop and give them a standing comparable to that of the foreigner in the treaty ports. In Young China the author finds no saving grace, believing that the teachings of liberalism among the pupils of missionaries and colleges founded by foreign associations are quite superficial and that the blundering of the Tuchuns and the divisions of the past decade represent a constant force in Chinese life. To him there seems no way to escape but through a powerful government—if necessary a restoration of the Manchu Dynasty—and the holding of the great mass of the people and the local governors in a strong grasp. He believes that to let democracy come in is to open the door to disintegrating influences and bribery in a more extreme form than it has existed in China during the whole period of foreign domination.

The case of the crowded population in the homeland of Japan is argued skillfully and carefully, and an important and necessary distinction is drawn between two forms of expansion by Japan, one form being an actual movement of population overseas as a result of the crowding at home, and the other a kind of economic penetration which is equally efficient in relieving pressure because the flow of capital into a new region may control the labor of the region and its output of raw materials, thus fostering industry at home and providing additional support or better support for the crowding millions.

One is tempted to say of Mr. Bland's conclusions that he is too ruthless a logician. It can be almost demonstrated that every new cause is a failure—until it has achieved a state of pronounced success! A thousand visible and invisible forces fight a new idea. Moreover, the followers of the new (as well as the old) always include a large number of foolish persons and "optimists *de metier*," as Mr. Bland happily phrases it. We must recognize, however, that this is a changing world and that the force of new ideas cannot be measured in terms of old customs and characteristics. Finally, it may be said with assurance that it is not the masses of the people, to whom Mr. Bland refers political and social doctrines at every turn, that have ever controlled the fate of revolutionary changes. The mass of the people is inert, neutral, and lacking in initiative. In all lands and times

the great changes have been brought about by the will of a determined minority who have succeeded in the long run because their policies and ideas have been sound with respect to the tendencies of a whole people.

## Geology and Geography of Central Celebes

E. C. Abendanon. **Voyages géologiques et géographiques à travers la Célèbes Centrale (1909-1910).** Vol. 1, xxvii and 443 pp.; diagrs., ills.; Vol. 2, xv and pp. 445–969; maps, diagrs., ills.; Vol. 3, xxii and pp. 971–1548; contributions of G. F. Dollfus, G. J. Hinde, J. H. Kruimel, S. J. Vermaes, and M. Weber, maps, ills.; Atlas, with the collaboration of J. J. Lefèvre, W. Schiebel, Raden Mas Amad, A. Raven, and W. F. Pandeij; sheets 1–12, 12B, 13–16. Publ. by the Royal Geographical Society of the Netherlands with the collaboration of the Ministry of the Colonies. E. J. Brill, Leyden, 1916–18. 11 x 8 inches. Atlas, 22 x 15 inches.

Of the numerous islands of the Malay Archipelago perhaps none is so interesting as the island of Celebes. Ever since the great English naturalist Alfred Russel Wallace made known to the scientific world more than sixty years ago the results of his observations, this island has been classical ground for the zoögeographer and naturalist. On the basis of his faunal studies he established what is known as the "Wallace line" which extends through the Strait of Macassar from north to south between Borneo and Celebes and which is supposed to be the dividing line between the Oriental and the Australian faunal regions. The controversy which followed this generalization had at least one beneficial effect in that it stimulated other naturalists to explore the island of Celebes more closely. The result is a vast amount of international literature bearing on this subject.

The establishment of the "Wallace line" involved the geological deduction that, during relatively recent geologic time, Celebes had belonged to the Australian continent, whereas Borneo had been part of the continent of Asia. But years elapsed before geologists participated in the discussion in the light of their own investigations on the ground. As a matter of fact, more or less systematic geological studies have been made only during the last twenty or perhaps thirty years. The names of Martin, Wichmann, Bücking, and the brothers Sarasin are worthy of mention as pioneers in this respect. During the last ten years, however, a change for the better has set in and, of late, very important geological work has been done by such men as Wanner, Ahlburg, Hirschi, Hotz, Gogarten, and especially by the Dutch mining engineer and geologist Abendanon. The results of his latest expedition, made in 1909–1910, have been published in the work under review, comprising three magnificent volumes with numerous text figures and beautiful plates, besides an atlas of maps and profiles.

The work deals particularly with the geology and geomorphology of the central part of the island; only scant and scattered reference is made to the response of human life to its particular environment as we now are wont to define geography. The first two volumes give a detailed description of the preparation for and the daily progress of the expedition which had as its main object a geologic and topographic reconnaissance of the region. The third volume summarizes the results achieved in their bearing on general problems. It includes reports from various specialists on the material collected on the trip, such as contributions on the paleontology by G. J. Hinde and G. F. Dollfus, on fresh-water molluscs by H. J. Kruimel, on fresh-water fishes by M. Weber, and on some phases of the economic geology by S J. Vermaes.

According to Abendanon the following elements, in addition to the coastal plains, can be recognized in the configuration of central Celebes:

1. A highly folded and faulted Pre-Cambrian gneiss-granite-schist complex in the central part.

All of it formed, during early Paleozoic time, part of a vast continent "Aequinoctia" (see E. C. Abendanon: Aequinoctia, an Old Paleozoic Continent, *Jour. of Geol.*, Vol. 27, 1919, pp. 562–578) and has since undergone submergence, upheaval, and peneplanation. Recent crustal movements have produced a network of *graben* and horsts. One of the major depressions is the Posso *graben*, some 75 kilometers long in a north to south direction, part of which is now occupied by a beautiful lake of that name. Another *graben* is the Fossa Sarasina—the Sarasin trough—to the west of the former. It is composed of a series of minor troughs in a north to south direction together about 100 kilometers long. Frequent earthquakes indicate that the crustal equilibrium in this part has not yet been established.

2. A coastal range to the west along the Strait of Macassar. As yet little more is known of this range beyond the fact that it is a folded chain of mountains of late Tertiary age.

3. An uplifted peneplain region to the east, the Verbeek Mountains, named after the Dutch geologist who has contributed so much to the geological investigation of the Dutch East Indies.

This region consists essentially of a peridotite batholith, at least 1,100 meters in thickness and of so vast an extent as to constitute, perhaps, the largest single occurrence of peridotite on record. This peridotite batholith of probable Mesozoic age is overlain, in places, by Pre-Tertiary sediments, 200–300 meters thick, part of which are highly folded.

The peridotite is nickel-bearing and may sometime become of great economic importance. The altered rock has given rise to extensive accumulations of lateritic iron ores similar to those found in Cuba but richer in iron and containing nickel in addition to smaller amounts of cobalt.

4. Several folded mountain ranges southwest of the central basal complex.

Some of these are composed of sedimentary deposits of Cretaceous and early Tertiary age; others are made up of various kinds of igneous rocks.

These ranges are separated from the mountains of southern Celebes by a depression running across the southern peninsula from the Gulf of Boni to the Strait of Macassar. This trough has become uplifted above sea level very recently, in Quaternary time; in fact, Abendanon has found evidence indicating that during the last fifty years the western part, at least, has been uplifted not less than five meters.

A short chapter treats of the peoples, who constitute three fairly distinct groups.

1. The coast people, who are Mohammedans and do not differ materially from the coastal people of other parts of the island. They are tradesmen and hardy navigators, but poor farmers.

2. The people of the mountainous regions, comprising different races known under the collective name of Toradjas. They are animists and live on the products of primitive agriculture and of the forests. They have developed arts and crafts to a relatively high degree. Aside from their passion for gambling they possess on the whole very desirable traits and have a capacity for higher development.

3. The primitive people of the dense forests, often heard of but not seen by the author except, perhaps, in a single instance.

A long chapter is devoted to the history of the cartography of the whole island of Celebes, from Ptolemy's time to the present, an exceedingly interesting review with numerous reproductions of historical maps as made by the earlier Portuguese and Dutch navigators.

The last chapter is given over to a short discussion of the origin of the word Celebes, which seems to have been derived from the native word "sellihe," equivalent to "current" or "stream," referring probably to the strong ocean current observed off the northeastern coast of the island.

M. W. SENSTIUS

## EXPLORATION IN CENTRAL BORNEO

CARL LUMHOLTZ. **Through Central Borneo: An Account of Two Years' Travel in the Land of the Head-hunters Between the Years 1913 and 1917.** Vol. 1, xix and 242 pp.; ills.; Vol. 2, x and pp. 243–467; map, ills., index. Charles Scribner's Sons, New York, 1920. 9½ x 6½ inches.

Dr. Carl Lumholtz, author of these two volumes of travel in central Borneo, died at Saranac Lake, May 6, 1922, at the age of 71 years. He was a Norwegian explorer and anthropologist of international repute. His first expedition was made in 1880–1884 to Australia as zoölogical collector for the Museums of the University of Christiania. Among his mammalian discoveries on this expedition was the tree kangaroo of Australia. A narrative of the expedition was given in "Among Cannibals" (1889). In 1890–1891 he headed an anthropological expedition for the American Museum of Natural History and the American Geographical Society to the northern Sierra Madre Occidental, which was followed by other expeditions in the Mexican field described in "Unknown Mexico" (1902). An expedition in 1909–1910 resulted in "New Trails in Mexico" (1912).

In August, 1913, Dr. Lumholtz set out from Christiania with the intention of exploring the unknown interior of New Guinea on an expedition financed by the King and Queen

of Norway, the Norwegian Geographical Society, the Royal Geographical Societies of London and of the Netherlands, as well as by private contributions. After his arrival at Batavia a short excursion was made to northeastern Dutch Borneo to secure a Dyak crew for the work in New Guinea. The Kayan River was ascended, and advantage was taken of opportunities for observation on the country traversed and its people. The return to Batavia, where a military escort and other assistance was to have been furnished, was coincident with the outbreak of the war, in consequence of which the Governor General felt obliged to withdraw his support and urged Lumholtz to postpone his trip. Later, however, arrangements were made for a second and more extensive expedition to central Borneo in substitution for that originally planned. On the second expedition the Barito River was ascended from Bandjermassin, the capital, at its mouth; the divide was crossed, and descent was made by the Mahakam River. Another excursion was made up the Katingan River west of Bandjermassin.

The 1914 census returns for the South and Eastern Division of Dutch Borneo—about half the island—to which Lumholtz's travels were confined, give a total population of about 906,000 people, of whom only 800 are whites. Some 817,000 are Dyaks and Malays; 86,000 are Chinese, and the remainder Arabs and other aliens. Borneo has a remarkably even, mild climate with copious rain and is rather more healthful than most equatorial regions. The forests contain much valuable hardwood timber; the chief native sources of income, however, are still rubber, rattan, and bamboo. Wild fruits of many kinds grow to perfection. More than 550 species of birds have been noted. Of importance are the mineral resources; chief of which are coal (bituminous), gold, iron, diamonds, petroleum, tin, and antimony. Gold is everywhere but has not yet been found in sufficient quantities to make extensive mining profitable. The lack of development of native resources is due to the fact that the white population is so small and the means of transportation so insufficient. The petroleum industry has reached important proportions, and a commission was appointed in 1917 to study the gold and iron possibilities in the Schwaner Mountains. There is much opportunity for agricultural development in the alluvial country among the rivers, but the natives still employ the most primitive of methods.

Although the general anthropological classification has been that the Malays inhabit the coast and the Dyaks the interior, several distinct tribes have been identified, some aboriginal and others immigrant. Both the Dutch and the British, however, employ the Malay designation of Dyak for all the native tribes except the nomadic. The author gives a detailed description of the Punans, the nomads of the jungle. Except where Malay influence has overcome the native characteristics, the natives were found to be an honest, trustworthy people. Dr. Lumholtz devotes the larger part of his volumes to a description of their languages, customs, and religions. Nearly half of the second volume is given to native legends and folklore. The illustrations, with which the first volume is particularly well furnished, are chiefly of native types.

## A Geographical Description of the Celebes

L. van Vuuren. **Het Gouvernement Celebes.** xxv and 535 pp.; maps, diagrs., ills., bibliogr., separate case of 23 maps. Encyclopaedisch Bureau, Vol. 1, 1920. Weltevreden, Batavia, Java. 11 x 8 inches.

The above volume, which appears to be only the first part of a compendious work, is particularly interesting as an indication of the earnestness with which Dutch East Indians are developing a knowledge of their superb possessions. The author is the chief director of the Encyclopedic Bureau by which the work is published. The volume now issued is devoted to a detailed geographical description of the island, largely in empirical form; beginning with the submarine slopes of the island (pp. 1–96), and continuing with its "horizontal form," particularly its coast. A great amount of authentic information is presented; but, physiographically considered, one must regret that the coast is treated in so great detail before the general form of the island, of which the coast is only a single contour line, is set forth. Many of the plates give good illustrations of coastal landscapes. A bibliography of 82 titles closes the volume.

W. M. Davis

## A Comprehensive Work on Greenland

G. C. Amdrup and others, edits. **Grönland i Tohundredaaret for Hans Egedes Landing.** *Meddelelser om Grönland*, Vol. 60, 174 + 567 pp.; maps, diagrs., ills., bibliogr.; Vol. 61, 795 pp.; maps, diagrs., indexes. With accompanying atlas of 20 plates. C. A. Reitzel, Copenhagen, 1921. 30 kroner. 10½ x 7 inches.

With the co-operation of a number of scientific men the Commission for the Geological and Geographical Survey of Greenland issued this comprehensive work in memory of the bicentennial of the disembarkation of Hans Egede in Greenland on July 3, 1721. It gives a systematic account of the country and of its development under Danish supremacy, principally on the basis of the wide and thorough researches during the last fifty years. The work is also meant to serve as a useful book of reference. These volumes are the result of the efforts of twenty-two editors and specialists and constitute a striking evidence of the co-operative ability of Danish scientific men. The volumes comprise a general synopsis, detailed descriptions of the different districts, biographical information, and a glossary with explanation of native names.

The general review gives a description of the natural conditions in the island and the surrounding seas—topography, geology, climate, glaciation, fauna, and flora. The Eskimos and their old culture—dress, houses, industries, tools, weapons, fishing gear, means of communication, social conditions, religion, etc.—are described.

On December 31, 1918, the total population of Greenland numbered 14,643, of whom 300 were Europeans. The distribution of the population in the different districts is given in detail in a number of tables. Other tables contain statistics of increase, distribution as to profession, birth and death, and causes of death.

Chapters are devoted to trade, fishing and hunting methods and results, business and communications, to administration, legal system, religion and education, sanitary conditions, language and literature, and scientific stations. The leading features of the history of Greenland from its discovery by Icelanders in the ninth century, together with the history of the scientific exploration of the island, are set forth.

The work is furnished with a number of good illustrations and is accompanied by an atlas with 20 maps, one of which is geological, most of them being topographical maps of the coast zone.

E. Antevs

## Myths and Tales from Greenland

Knud Rasmussen. **Myter og Sagn fra Grönland.** 375 pp.; map, ills. Gyldendalske Boghandel, Nordisk Forlag, Copenhagen, Christiania, Berlin, London, 1921. 9½ x 6 inches.

Knud Rasmussen is peculiarly fitted by birth, training, and experience to work among the Eskimos, for they are, in a sense of which he is very proud, his own people. He is part Eskimo himself, his great-grandmother having been a South Greenland woman. His first education came from Greenland schools, and, though he later graduated from the University of Copenhagen, majoring in the Eskimo language, the fundamentals he learned in the little Greenland schools are still the basis of his knowledge. He speaks fluently the language and the dialect of every group along the Greenland coast.

For thirty years he has traveled the Greenland shores from Cape Farewell to the northernmost cape. He has visited every village and every group from Angmagsalik to Cape York. He has explored long reaches of unknown coast and traveled tens of thousands of miles by sledge and kayak with only Eskimo companions. He has lived their life, suffered their hardships and hazards, known their inmost thought, for thirty years. He has studied them as one of them.

In the complete collection of Eskimo tales and myths from Greenland which he presents in this book, he has gathered together the entire product of his long labors on the Greenland coast. From the Eskimos themselves he has gathered all this rich harvest of folklore and mythology and legend and tradition—sitting beside them in their igloos and writing down their tales by the light of their little blubber lamps; camping with them on their long hunts for caribou or bear or narwhal; sledding with them on far exploratory journeys; dancing and singing with them in the storehouses at the trading stations; always recording every new story, every significant observation.

The divisions of the book indicate the inclusiveness of the well organized matter: Eskimo Mythology; Conception of Nature; Animal Fables; Epic Tales; Meetings with Foreign Races; Curious Stories; Songs and Dialogues. Each division comprises several chapters.

The style is clear and forceful. Rasmussen indeed is no less an author than explorer and scientist, and as such he is well recognized among his countrymen. To anyone interested in the Eskimos, or the Far North, or the folklore of a passing race this book appeals with double charm; to the casual reader it is interesting, instructive, entertaining. An English rendition entitled "Eskimo Folk-Tales" (London, 1921) is reviewed in the July number of the *Geographical Journal.*

W. Elmer Ekblaw

## Narrative of the Second Thule Expedition

Knud Rasmussen. **Greenland by the Polar Sea: The Story of the Thule Expedition from Melville Bay to Cape Morris Jesup.** Preface by Admiral Sir Lewis Beaumont. xxiii and 327 pp.; maps, ills., index. Frederick A. Stokes Co., New York, 1921. 10 x 8 inches.

While this English translation of Knud Rasmussen's most ambitious work does not entirely convey the fine spirit of the Danish original, it is nevertheless one of the most noteworthy contributions of this generation to the ever-fascinating field of Arctic exploration and the translators have succeeded in transferring faithfully Rasmussen's picture of the character of the Greenland coast, its scenery, life, and people. The subject matter of the original has for purposes of expediency been condensed and abbreviated, but nothing relevant to the purpose of the book has been omitted.

It will be recalled that the Second Thule Expedition, in reality Rasmussen's fourth Thule expedition, left Denmark in 1916 with primary purpose "to survey and chart the last unknown reach of Greenland's north coast between St. George Fiord and De Long Fiord." Its secondary objects were (1) to prove or disprove that migrations of the Eskimos take place around the northern end of Greenland from the west to the east coasts, long a mooted subject of discussion among the students of Eskimo dispersal; (2) to survey and map geologically the long extent of coast from Sherard Osborn Fiord to Peary Land, which was still blank on the geological map; (3) to keep meteorological records and to collect botanical and zoölogical material. The scientific results are stated in three appendixes (compare "Scientific Results of the Second Thule Expedition to Northern Greenland, 1916–1918," *Geogr. Rev.*, Vol. 8, 1919, pp. 180–187). The narrative is given in fifteen chapters which lead from the account of the Polar Eskimos, their land and life, the preparations for the long journey along the northwestern coast of Greenland and across the ice cap; through its arduous accomplishment to the homeward journey; and the losing race with death to save the life of the botanist, Dr. Thorild Wulff, the most trying and discouraging part of the trip. The chapter "A Runic Memorial" closes the volume fittingly.

The Second Thule Expedition was daring in plan and faithfully persistent in accomplishment. It is admirably recorded in "Greenland by the Polar Sea."

W. Elmer Ekblaw

## An Expedition to Novaya Zemlya

Charles Bénard. **Un été chez les Samoyèdes (Juillet-Octobre 1914).** 4th edit. xii and 228 pp.; map, diagrs., ills. Plon-Nourrit & Co., Paris, 1921. 9 fr. 7½ x 5 inches.

In this volume Commandant Bénard, president of the Oceanographical Society of France, tells the story of a visit, cut short by the outbreak of war, to Novaya Zemlya, in 1914. His sojourn of two months and the account of it given here are the sequel of a former expedition (1908) of which a report was published under the title, "Dans l'océan glacial et en Nouvelle-Zemble" (1909). Some of the illustrations to the present volume appeared first in the other.

Commandant Bénard's plan of campaign in 1914 was to proceed to Novaya Zemlya by the Russian steamer which, once a year, in July, used to take provisions to the small Samoyed population of the southern island. Landing at Belusha Couba, near the western extremity of Kostin Strait, the passage which separates Mezhdusharski Island from the southwestern coast of Novaya Zemlya, he was to complete the map of the Strait, "at least

in a descriptive manner," cross Novaya Zemlya in the latitude of the Strait accompanied by a Samoyed with a sledge and a team of dogs, then make for a point, northeast of Goose Land, the peninsula which stretches north from Kostin Strait, by a different route from that followed by Chernyshev (1895). Finally, he was to return to Belusha Couba, crossing Goose Land from north to south. Failure to find dogs enough and a Samoyed willing to accompany him at Belusha Couba resulted in a modification of his plans. He carried out a brief reconnaissance of the Strait in a whaleboat, made a dash on foot and alone across the main island, and returned to Belusha Couba, where he eventually managed to persuade one of the Samoyeds to build for him a light sledge, provide a team of dogs, and accompany him across Goose Land on foot, using the sledge for the conveyance of a tent, surveying apparatus, and provisions.

The principal results of M. Bénard's expedition were to establish the fact that Goose Land is a low-lying plain, innocent of the mountains which have hitherto figured on the map "in fantastic fashion," to add three fiords to the coast line of Kostin Strait, and to ascertain the direction—north and south—of the chains of rugged hills which flank Goose Land on the east, parallel with the chain of the central divide. There is an interesting account and explanation of the nature and the disintegrating effect on the surface of the southern island of the peculiar *bouffettes*, a sort of pustule, as it were, of mud which crop up everywhere among the fractured schists of which the land is principally composed.

The corrections of the existing maps are made almost entirely "in a descriptive manner." There is one small sketch map in the book. It contains no indications of the relief. Few of the places named in the text are marked on the map. A short chapter only, in spite of the title of the book, is devoted to observations on the life and manners of the Samoyeds of the regions visited.

With the limitations indicated, M. Bénard's volume is a welcome contribution to the rather scanty geographical literature of the region. There is a useful discussion of the routes through the Barents and Kara Seas, as conditioned by the prevailing winds, the direction of the currents, and the ice.

H. U. HALL

## A REGIONAL GEOGRAPHY OF FRANCE

EMMANUEL DE MARTONNE. **Les régions géographiques de la France.** 190 pp.; maps, diagrs., bibliogr. (Bibliothèque de Culture générale.) Ernest Flammarion, Paris, 1921. 4 frs. 50. 7½ x 4½ inches.

France has been the subject of more valuable regional studies than any other country, thanks to the influence of the late Paul Vidal de la Blache, who himself composed the model in his "Tableau." Some of his pupils, as is well known, have applied his method in their studies of a number of the separate regions of France, all of which form admirable treatises. And now one of them, Professor de Martonne, has presented the geography of almost the whole country in an original form and, in doing so, has achieved remarkable success. The publication of this work is of special interest to Americans because it has developed from a series of lectures delivered by M. de Martonne first at Columbia University and later at the Sorbonne, where they were specially designed for foreign students. It is significant that this book, which is real geography from start to finish, finds a place in a "Library of General Culture," to which indeed it is admirably suited. The author has striven—and one may hope has succeeded—to depict and explain "to any cultivated and curious mind" the varied aspect and resources of the soil of France; and the method he has chosen for thus arousing the interest of the general reader could scarcely be bettered.

The author plunges *in medias res* with a description of Paris—its position, site, growth advantages and disadvantages—in the first chapter and follows with successive chapters on the Paris region and basin, Picardy and the Champagne, Lorraine, the Vosges and Alsace, and so on over the most of France. It may be surmised that the reader will thus gain an appreciation of the meaning of geography and will be prepared to fill out the gaps from other sources. This book alone leads to an intelligent appreciation of the varied landscapes of France and of the intimate and manifold associations of land and people in the different contrasted regions; but it gives the reader no idea of the geography of France as a unit. We are left with the feeling that a chapter is lacking which would pull the regions together and sketch the homeland of the French people in lines as decisive and

impressionistic as those which outline so satisfactorily each of the component parts. Such a chapter, it would appear, the author might well have worked in to the advantage of this otherwise excellent book without attempting to make it a complete geography of France with full treatment of distributions, physical and human, which can quite well be sought for in other books and atlases. Illustration is limited to a few block diagrams, and it is essential that a good atlas be before the reader; and where possible the maps of the Service Géographique de l'Armée—either on 1 : 600,000 or 1 : 200,000—should be consulted.

Having noted these omissions we may characterize M. de Martonne's work by stating that we know of no more concise and telling geographical description at once vivid and explanatory which has so successfully encompassed a territory of the area and variety of France within 190 short pages. Not a word is superfluous, and the style is easy and attractive. With his reputation as a physical geographer the author could be counted on to provide lucid accounts of the various land forms and their origin. These are present but not overweighted, and they are deftly worked into landscape description in such a way that man is the central figure. Nowhere is local patriotism stronger than in France; and in no civilized country is man more directly dependent upon the soil. France excels, then, as a field for the study of the relationships between man and his habitat, and we are grateful to Professor de Martonne for presenting a great subject in simple language.

## The Rocky Mountain Trench

S. J. Schofield. **The Origin of the Rocky Mountain Trench, B. C.** Maps, diagrs. *Proc. and Trans. Royal Soc. of Canada*, Ser. 3, Vol. 14, 1920, Section IV, pp. 61–97.

F. P. Shepard. **The Structural Relation of the Purcell Range and the Rocky Mountains of Canada.** Maps, diagrs. *Journ. of Geol.*, Vol. 30, 1922, No. 2, pp. 130–139.

Because the Rocky Mountain trench is the "most remarkable structural feature of the Canadian Cordillera" any addition to our knowledge of it is of wide geographical interest. The trench forms the western boundary of the Rocky Mountains of Canada practically throughout its whole length for a distance of over 800 miles. Its direction is almost constant north 33° west. In it are the headwaters of nine considerable streams. The sides of the trench rise on an average 4,500 feet above the valley floor; the width averages 4 to 6 miles; the floor is flat or slightly rolling; and, finally, glaciation has smoothed and trimmed its interlocking spurs to such an extent as to increase its linear quality and give it its modern trough-like characteristics.

Of particular interest in physiography are the series of cross sections on page 74 of Schofield's paper and the accompanying discussion of evidences of faulting. Schofield, following Daly, considers that the origin of the trench in an almost continuous zone of faulting is now well established. It is his belief that sharp changes in rock character in short distances at a few localities where actual faults have been observed and other pronounced structural features from which faulting is clearly inferred furnish a strong basis for a definite conclusion on this question. The normal faulting in evidence probably took place in Eocene time. It produced not only a depression but also a zone of shearing along which rivers would tend to erode rapidly. The author discusses at some length the effects of erosion in Cretaceous time and the reduction of the highlands to a peneplain. In this fact and in subsequent broad crustal movements, coupled with the structural features of the Rocky Mountain trench, we have an explanation of the drainage relations of today. These relations are traced out in considerable detail; but the history of Pleistocene and recent drainage in British Columbia is not discussed, the reader being referred to Dawson's famous paper read before the Royal Society of Canada in 1889.

Shepard takes issue with Schofield and Daly with respect to the explanation outlined above. From a study of 180 miles of the Rocky Mountain trench between Gateway, Mont., and Golden, B. C., he concludes that it is not a unit in development and structure but that its different parts have had different origins—"partly by normal erosion, partly by erosion along lines of structural weakness, and partly by the escarpment of a fault (*sic*)." The faulting adjudged to be operative was of the thrust rather than of the normal type. It was a zone of weakness at the present locus of the trench in the Purcell Mountain region, caused by the intersection of a large number of fault planes, that hastened the erosive processes.

In the central section of the stretch studied by Shepard (Canal Flats to Bull River) there appears to be no relation between the trend of the trench and the structural lines. From this fact and the great width of this part of the trench, greater age is inferred, such as would be associated with a peneplaned surface where drainage had freed itself from the bondage of earlier structural and topographic controls.

## Drift of the Earth's Crust and Displacement of the Pole

Alfred Wegener. **Die Entstehung der Kontinente und Ozeane.** 2nd edit. viii and 135 pp.; maps, diagrs., index. *Die Wissenschaft: Sammlung von Einzeldarstellungen aus den Gebieten der Naturwissenschaft und der Technik No. 66.* Friedr. Vieweg & Son, Brunswick, 1920.

Wladimir Köppen. **Polwanderungen, Verschiebungen der Kontinente und Klimageschichte.** Maps, diagrs. *Petermanns Mitt.*, Vol. 67, 1921, January-February, pp. 1–8; March, pp. 57–63.

Wladimir Köppen. **Ursachen und Wirkungen der Kontinentenverschiebungen und Polwanderungen.** Diagrs. *Petermanns Mitt.*, Vol. 67, 1921, July–August, pp. 145–149; September, pp. 191–194.

The authors are meteorologists stationed at the Marine Observatory at Hamburg; they have apparently worked more or less in conjunction and cover very much the same ground in their publications. Wegener is more detailed in his description of the displacements of the continents; Köppen, of the changes of the earth's axis of rotation. The picture they present of the history of the earth's crust is as follows. The material of the upper 1,500 kilometers of the earth's crust is of two kinds, Suess' *sima* (rock rich in magnesium) and *sial* (rich in aluminium), Suess' *sal*. The latter is less dense than the former, is very much less in amount, and floats in it as icebergs float in water. The authors draw confirmation of this idea from the hypsometric curve, and Wegener gives a rather striking diagram of the relative areas at different levels of the lithosphere, showing the preponderance of a continental and an oceanic plateau, as first described by Murray. The sima is highly viscous and reacts as a solid to temporary forces but yields to long-continued forces. The sial is much more rigid and, though capable of being folded, is more apt to fracture. At the beginning of geological time, the sima layer was entirely covered by a mantle of sial about 30 kilometers thick. For some reason not given, this broke up and the sial collected together in a single mass (with some gaps), about 100 kilometers thick, to form the continents. Then the process was reversed, and one part after another broke away and floated off, with the result finally of the present distribution of the continents. By selecting the times of the various disruptions, by assuming great changes in the position of the earth's poles, and by introducing other hypotheses where needed the authors attempt to account for the variations in geological climates, for the distribution of former and recent fauna and flora, for glaciation and for many mountain chains. During Carboniferous and Permian times the disruption had scarcely started: the American continents were in contact with Europe and Africa; the latter, Antarctica, Australia, and India (which then stretched far to the south) were continuous; and the south pole of the earth lay in southern Africa. The existence of a common Permian glaciation in these countries is thus accounted for, for the authors think that strong glaciation is due to nearness to a pole lying in a land area. They overlook the evidence of glaciation in the mid-Carboniferous in Oklahoma and in the Permian in Massachusetts, England, and Germany—regions which were then quite close to their equator. Some similarities in the geological fauna and flora of the southern areas are also explained by their juxtaposition. The two parts of the Hercynian mountain range of the eastern and western hemispheres were united, as the north Atlantic ocean had not yet been formed. In the Eocene, things began to happen. Taking Africa as our point of reference, we may consider it at rest; Australia broke away and moved off to the east; Antarctica slipped off to the south; India to the northeast, crumpling up the mass in front of it to form the Himalayas; South America began to pull away from South Africa; but it was not until the Quaternary that northeastern North America, Greenland, and northwestern Europe were torn apart. Hence the distribution of glaciation during the Pleistocene ice age in the two continents, for, at that time, the north pole is supposed to have been in the present north Atlantic and about 20° from its present position.

Wegener is quite right in saying that in reconstructing the geography before the folding of a mountain range the greater area required by the smoothing out of the folds should be considered, a point not sufficiently taken into account by paleogeographers; but he is wrong in supposing that the Himalayas were folded in the Tertiary; they were elevated in this period, but the folding was earlier.

The continents being formed of light sial stood higher than the ocean basins, which consisted of sima. Therefore the centrifugal force due to the earth's rotation would tend to move them towards the equator. We find no calculations to show the competency of this force, but it is quite certain, according to the map drawn by Wegener, that the continents never did cluster about the equator. On the contrary, their general drift is supposed to have been westward. It is suggested that this westward drift may be due to the same cause as the westward direction of the trade winds, namely, the influence of the rotating earth on matter approaching the equator. But the authors do not claim that the American continents have shown any definite movement toward the equator; so the suggested explanation of the westward drift is inapplicable.

Wegener finds confirmation of the western drift of Greenland in the determinations of longitude made there in 1823, 1870, and 1907 by Sabine, Payer, and Koch respectively. They apparently show a westward movement of Greenland averaging 9 meters a year during the first interval and 32 during the second. The observations were made on the east coast of Greenland in latitude about 75° N., and the changes of longitude found seem to be outside the errors of observation. Foldings of the strata and the great overthrust faults teach us that parts of the lithosphere do move horizontally, and we have definite measures of movements along the western coast of the United States and in the island of Sumatra. If the movement of this part of Greenland should be confirmed, it would naturally be classed with those mentioned; but it would not indicate a general westward drift of the Americas. A movement of 32 meters a year is of the order of movement of the ice of moderately large Alpine glaciers; it is 500 times as large as the measured movement on the Pacific coast.

The resistance the sima of the ocean bed of the Pacific Ocean offered to the western drift caused a folding and crumpling up of the western border of the Americas, forming the Andes and the western mountains of North America. The same objection applies to this case as to the Himalayas; the folding occurred earlier. The great deeps along the South American coast are supposed to be due to the sinking of the sima to allow the lighter sial to pass over it. Experience indicates that the pressure of a moving mass would cause an elevation of a viscous substance in front of it. Where mountain ranges are formed away from the front of a moving continent, such as those of central Asia, they are supposed to be due to variations in the friction in the sima below. The ocean bottom is supposed to be smooth and featureless—an old idea, which modern soundings do not confirm. It is supposed to be free from foldings; of this we are entirely ignorant. The group of festooned islands off the eastern coast of Asia, together with the Antilles, are supposed to have been broken off and held back by special friction from the westward-drifting continents. The Atlantic islands are supposed to be carried off from Africa by special currents in the sima. The mid-Atlantic ridge is supposed to be formed by deposits when only a narrow strait had been formed between Africa and South America; but the ridge is far from either continent. The elasticity of the hypothesis is evident.

The authors accept the principle of isostasy, as indeed their general hypothesis requires; but they do not hesitate to assume lack of isostatic adjustment where it is indicated by their hypothesis. As we have not properly reduced gravity measures in these regions, the matter cannot be tested. When mountain ranges are formed by compression the lighter sial is forced down as well as up to satisfy isostasy. This is Osmond Fisher's idea, based on Airy's paper of 1855. The objection to it is that, at any rate many mountain ranges were elevated long after they were folded (see a paper on "Isostasy and Earth Movements," *Bull. Geol. Soc. of Amer.*, Vol. 33, 1922, pp. 317–326).

The explanation of the geologic climates by the displacement of the pole has been a favorite speculation of many geologists; and our authors use it to the full. The distance between the positions of the pole in the Carboniferous and in the Pleistocene would, according to them, be about 65°; but the length of the path followed from the former time to the present would be three times as much. There are difficulties in the way of such assumptions. It is curious that Köppen thinks that justice requires him to mention an obscure work, full of inaccuracies, whereas neither author mentions the classical paper

of George H. Darwin, "On the Influence of Geological Changes on the Earth's Axis of Rotation" (*Proc. Royal Soc.*, Vol. 25, 1876–77, pp. 328–332). Köppen reports at length a paper by G. V. Schiaparelli (1889), which, so far as I can judge from his account, is merely an elaboration of a part of Darwin's work. His argument is this, that though the axis of rotation of a rigid earth could not depart more than a few degrees from its axis of figure, as a result of any possible geological changes, the axis of a plastic earth could be changed indefinitely under a continuing cause. You will find that in Darwin. But where is the cause? It is easy to see from Darwin's calculations that if the North American continent were floated off from Europe to a distance of 90° to the west, the displacement of the pole would be only a few minutes of arc; which would, moreover, be partially counteracted by the simultaneous drift of South America. Such changes cannot occur repeatedly. What geological changes can be imagined that will continue to move the pole *in the same direction* through 65°? Our authors suggest none.

The hypothesis of the movements of the pole and the drift of the continents was adopted to fit certain facts, such as the reciprocal outlines of South America and Africa, the principal location of Permian glaciation, etc.; but, as has been shown, it does not fit other facts. As a further instance, the position of the north pole in Eocene time was placed about as far from Alaska as it now is, but on the other side. We should therefore expect a cold climate in Alaska during the Eocene; but this is just the time that the climate there was warmest, as far as we know. Our authors rely on many of the older estimates of geological temperatures, which require modifications in the light of later studies.

There have been many attempts to deduce the characteristics of the earth from a hypothesis; but they have all failed. There is the pentagonal system of Élie de Beaumont, the tetradedral system of Green; and others might be mentioned. This is another of the same type. Science has developed by the painstaking comparison of observations and, through close induction, by taking one short step backwards to their cause; not by first guessing at the cause and then deducing the phenomena.

HARRY FIELDING REID

## WALL ATLAS OF COMMERCIAL GEOGRAPHY

GEORGE PHILIP. **Philips' Comparative Wall Atlas of Commercial Development.** A set of eight maps, size 42 by 34 inches: (1) World, 1: 40,000,000; (2) Europe, 1: 6,000,000; (3) Asia, 1: 12,000,000; (4) Africa, 1: 9,000,000; (5) North America, 1: 9,000,000; (6) South America, 1: 9,000,000; (7) Australasia, 1: 6,000,000; (8) British Isles, 1: 1,000,000. George Philip & Son, Ltd., London, [1922.] 3s. 6d. each, unmounted.

Geography as an interpretative science is greatly indebted to the house of Philip. They gave us a few years ago an invaluable set of maps, the "Comparative Wall Atlas." In this set, for instance, the map of natural vegetation went beyond the miserable confusing designation that had been used so disappointingly before under the title of "woodland, grass, and cultivation." These maps are real geography in a visible, quickly understandable, and highly effective form.

The announcement of a new series was greatly anticipated by the reviewer, but he must confess to considerable disappointment. The purpose and method of construction of the present series of maps of commercial development were described and exhibited before the Royal Geographical Society some years ago (George Philip: A New Series of Economic Maps for School Use, *Geogr. Journ.*, Vol. 50, 1917, pp. 438–447). Mr. Philip then said: "How, then, within the limits imposed by the size to which a school atlas is restricted, and the number of maps which it can afford to devote to economic geography, can we prepare a really useful series of economic maps? After experimenting on various lines, I decided that the right method to adopt was to associate the distribution of the population with the nature of its economic activities. This conclusion meant in effect that the groundwork of the economic map should be formed by the combination of a map showing the density or distribution of the population and a map showing regional vegetation. Only by weaving together the materials supplied by these two maps did it seem possible to obtain the basis for a reliable representation of the progress achieved by man in his exploitation of the world and its resources, and of the general character of his various occupations."

The new series has appeared in the form of wall maps, but it may very properly be called an atlas also. One must walk up close to the maps to see what is on them. Some useful information of this sort is the table printed on a white patch in the blue ocean near each port showing its total exports and imports and several of the leading articles of both import and export arranged in order of importance. The maps are mines of information to be painfully studied at close range. The process indeed is painful because of the confusion that arises largely from the working out of the fundamental idea of "weaving together" the data of population distribution and vegetation. Thus one color is given for land (agricultural, pastoral, and forest) with one population density, and an entirely different color for the same sort of land with a different population density. The result of this is that the forests of Sweden and the almost grassless and quite treeless steppes east of the Volga appear in the same color. For undeveloped parts of the world some of the maps are much better; for example, regions of different kind of forest in Labrador, Canada, and Alaska are shown with great minuteness; the areas of virgin tropical forest come out quite clearly where there is no agriculture to confuse.

The sense of confusion is increased by the use of colors that vary from each other so little that the ordinary person has difficulty in carrying the distinction from the legend of the map. This seems almost inexcusable when one considers that the maps are quite likely to fade somewhat and, in the second place, that for years it has been customary to use a small figure to carry identification in cases of this sort. The world map of occupations is better than the continent maps because the attempt to weave together two different things has been abandoned; but here we still face the difficulty of color identification.

The makers of the series have fortunately taken the advice of the British Association and avoided the hopeless business of trying to show economic phenomena by writing words or letters on the maps. They have adopted instead seven or eight symbols in red to show iron, copper, tin, diamonds, gold, coal fields, petroleum. One of the interesting results of this method is to show on North America by the red hollow squares iron in eastern Tennessee, on the Virginia-Carolina boundary not far from Norfolk, at Butte, Mont., at Madison, Wis., but none at Chicago, Pittsburgh, or Buffalo.

The question of accuracy or up-to-dateness of information is brought slightly into question when one sees the designation "Regions Incapable of Development" (desert, tundra, Alpine, etc.) and observes that it is made to cover four-fifths of Alaska and those parts of Canada where Stefansson has described herds of caribou so large that they covered acres or even square miles and took days to pass, with total numbers which ran into the millions. Indeed these caribou herds are beyond doubt the greatest masses of meat animals to be found anywhere on the earth today.

The maps show at a glance by the size of the band in the ocean the value of commerce for certain routes, and here they are entirely different from all previous maps of this sort, which indicates that either the other maps are wrong or that this one is using war valuations; but there is no date to make us certain about this.

In the corner of the world map is an inset showing the means of communication, including beasts of burden; and ice-closed seas are also indicated—a valuable addition here and on the continent maps where it figures.

As it is, the reviewer expects to go back to Philip's earlier series and have his students use it in conjunction with Finch and Baker's "Atlas of World Agriculture" and the U. S. Geological Survey's "Atlas of Mineral Resources." If Messrs. Philip would simplify the maps of Commercial Development to some extent, he would probably wish to use them; but these good workers have fallen prey to the very natural impulse to overload that greatest of all printed pages, the map.

J. Russell Smith

## Two British Textbooks of Geography

R. N. Rudmose Brown. **The Principles of Economic Geography.** xv and 208 pp.; bibliogr., index. Sir Isaac Pitman & Sons, Ltd., London, Melbourne, Toronto, New York, 1920. 8½ x 5½ inches.

O. J. R. Howarth. **A Commercial Geography of the World.** 2nd edit. 235 pp.; maps, diagrs., index. (The Oxford Geographies.) Clarendon Press, Oxford, 1920. $1.80. 7½ x 5 inches.

"Principles of Economic Geography" is a book of two hundred and eight pages, eighty thousand words, without a map, picture, graph, or diagram. It tries to cover everything

including self-determination, molybdenum, rocks, soils, and climate. Divisions of space are interesting: corn (maize)—1 page; pigs—16 lines; molybdenum—10 lines; nitrates—11 lines; causes of emigration—20 lines; Northeast and Northwest Passages—1 page (39 lines); slave trade—3½ pages.

Furthermore, there are many mistakes in statements of fact. "Brazil overshadows all other countries in annual output" [of rubber] (p. 50). The book was copyrighted in 1920, two years after the collapse in the rubber price resulting from the enormous cultivations in the Orient which had far surpassed poor Brazil in amount. The author's knowledge of rubber appears to be botanic, encyclopedic, about ten years behind the time, and with no economic flavor worth mentioning. Turning over a page one sees that Egypt produced in the year 1918–1919 4,800,000 bales (of 400 lbs.) of cotton. The United States Department of Agriculture puts it at 1,304,000 bales (of 478 lbs. net) in 1918; 999,000 in 1919.

I believe in a liberal forgiveness for mistakes, but the above-mentioned are egregious. So is this: "Warm currents wash the western coasts (in temperate regions), and the prevailing winds are from the south and west." Most of the children's geographies in America have a special designation to show that the currents along the western coasts of South America and Africa and California are *cold* or *cool*. I wonder how the author would prove his statement that "Slavery in Africa, or even in Mediterranean Europe, was a kindly bondage compared to what the black man had to face in America." What is Africa's record of slavery?

In some places the book does come up to definition and discuss *principles*, which I believe are *ideas;* but some of the discussion is of political geography, and most of it is merely another case of the statements of fact without cause or result so common on the other side in books which Mr. Cundall recently called, very properly, "mere cramming implements."

Perhaps much of the trouble is indicated by the author's remarkable statement in the introduction. In discussing the scope of economic geography and its relation to various other sciences he says, "An adequate knowledge of the tributary sciences is helpful but not essential to the geographer." I want to emphasize the opposite idea most emphatically. One of the chief handicaps of geography at this moment is that it has so *few* men adequately trained in tributary sciences. I hope we do not have to await the creation of these men before we have a real "Principles of Economic Geography."

Howarth's little book of 234 small pages, about 55,000 words, is smaller than Rudmose Brown's; other than this it offers great contrast. It is *full of geography*, splendidly illustrated, with 33 inexpensive black-and-white maps that carry points very effectively. One of these is a map of southeastern Asia showing rice regions by dots and heavy population by heavy vertical rulings, indicating striking similarity in location of the two factors.

The chapter titles show the plan. They are: General Considerations, Cold Regions, Temperate Lands, Temperate Lands (*cont.*), Hot Lands, Fisheries, Mining and Manufactures, Transport, Trading Centers, Grain Trade, British Isles, Scandinavia and Russia, Central Europe, European Mediterranean and Balkans, North America, Temperate Lands in Southern Hemisphere, The Monsoonal and Other Asiatic Territories, The Hot Lands in Africa and America, and the Pacific Islands.

The book starts by reproducing Herbertson's well-known Natural Regions Map. The first half of the book, which shows much thought, continually ties back to this piece of fundamental geography. The latter part of the work is less geographic and more encyclopedic—often mere statements that this or that is here or there.

J. Russell Smith

## Some Meteorological Books

George A. Clarke. **Clouds: A Descriptive Illustrated Guide-Book to the Observation and Classification of Clouds.** With a Preface by Sir Napier Shaw. xvi and 136 pp.; maps, diagrs., ills., index. E. P. Dutton & Co., New York. $8.00. 8½ x 5½ inches.

A. E. M. Geddes. **Meteorology: An Introductory Treatise.** xx and 390 pp.; maps, diagrs., ills., index. Blackie & Son, Ltd., London, Glasgow, and Bombay, 1921. 21 s. 9 x 6 inches.

R. G. K. Lempfert. **Meteorology.** x and 186 pp.; maps, diagrs., ills., index. Methuen & Co., Ltd., London, 1920. 7s., 6d. 7½ x 5 inches.

Mr. Clarke's book on clouds is well described in the subtitle: he has contributed a unique collection of photographs, the faithful effort of many years; and the publishers have done their part equally well. There are four color plates—all unique and excellent though per-

haps a trifle vivid, seventy-two photographs, and seventeen diagrams and figures. No one who admires skyscapes should be without this book; for it gives with well chosen illustrations and in carefully written text about all that one ordinarily wishes to know about clouds.

While recognizing that it needs overhauling, Mr. Clarke accepts the International Classification of the clouds, which embraces five general divisions and ten types. There are types, however, which lie outside this scheme; and these, like the mammato-cumulus, the lenticularis, and the turret clouds, are listed separately.

A rather brief account of cloud velocities is given, and it is evident that it is not the practice at British meteorological stations to get actual velocities. A Fineman nephoscope is employed, and only angular velocities are recorded. If these are reduced, using average values for the types of cloud as given in the International Classification, the average actual velocities are: cirrus, 60 miles per hour; cirro-stratus, 60; cirro-cumulus, 45; alto-cumulus, 30; alto-stratus, 35; strato-cumulus, 22; cumulo-nimbus (central mass), 35; and cumulus, 31. Mr. Clarke adds that some of the individual velocities for cirrus are very high; for, assuming the cloud to have been only 23,000 feet instead of the 30,000 feet given as the average, the velocities not infrequently reached 100 or 130 miles per hour. Our author may feel justified now in using the higher value, for by direct measurement at Blue Hill Observatory, a cirrus cloud has been recorded traveling at the rate of 102.6 meters per second, that is 228 miles per hour. There are supporting records on various dates of 94 meters per second (210 miles per hour) and 84 meters per second (188 miles per hour). Velocities of 60 meters per second, or 130 miles per hour, are not infrequent.

Four striking photographs of the upper surfaces of cumuli and strato-cumuli made in an airplane (old style aeroplane) by Captain C. K. M. Douglas, are added to the sixty-eight cloud photographs of Mr. Clarke. These were made at heights of 3,000 meters.

It is a little singular that there is no reference to Clayton's first-class work at Blue Hill and only a reference at second hand to Bigelow's extensive report. We might mention too, that no details concerning the photographic methods employed are given. It is all very well to show beautiful photographs; but in a book of this character a few words of advice and instruction to those who would like to try their prentice hand "catching the clouds" would be much appreciated.

Dr. Geddes, a lecturer in natural philosophy in the University of Aberdeen, who adds to classroom experience knowledge gained during the war in the Meteorological Section of the Royal Engineers, has given us an unusually lucid and well written textbook. Recognizing that there are others in the world besides undergraduates, he writes for aviator, farmer, sailor, and even the holiday-maker. The lengthy introduction contains a strong plea for an educated public; for something more than Weather Bureau or even a Meteorological Society; and we agree that this is necessary if weather observations and forecasts are to be understood and utilized to full advantage. Dr. Geddes is right in saying "There is perhaps no other subject which attracts the attention of so many people, yet perhaps there is no other subject about which so many false ideas exist."

The succeeding chapters deal with the Atmosphere, Radiation, Temperature, Pressure and the General Circulation, Water Vapor, the Minor Circulations, the Free Atmosphere, Atmospheric Electricity, Atmospheric Optics, Atmospheric Acoustics, and Weather Forecasting and Climate.

Dr. Geddes is a physicist and so clearly recognizes the value of employing scientific units. For temperature, he says, referring to the absolute Centigrade scale, "this scale is the only scale on which there is a definitely fixed temperature, the absolute zero of temperature." He is evidently not aware of the Kelvin-kilograde scale. He says, "I have employed the gas scale [the absolute Centigrade] throughout." But the types have played him false, for Figures 1 and 2, thermograph records August 1 and August 3, 1919, at Aberdeen, are in degrees Fahrenheit, without even equivalent values. The time scale, however, shows that the Aberdonians (and this is generally true of British observers) are ahead of Americans, for the hour which we call 11 P. M. they call 23.

The book is one which the professional meteorologist will find convenient for reference, and the layman will find not only readable but stimulating.

In "Meteorology" Mr. Lempfert has endeavored to present in simple speech, and we may add in attractive dress, the chief results derived from modern methods of air exploration. In fact, he brings up to date Dickson's volume on "Meteorology" which appeared in the University Extension Series about 1893. The observational side is subordinated to dynamical studies; and climatological data and descriptions of instruments have been omitted.

As Superintendent of the Forecast Division of the British Meteorological Office, Mr. Lempfert is well qualified to set forth the possibilities—and limitations—of the synoptic map, on which, as we all know, official forecasters rely.

The Weather Map is explained in detail, and the somewhat astonishing statement is made that "despite the fact that maps have now been drawn day by day for over half a century, we may safely say that no two maps have been identical." For that matter, no two snow crystals are identical; but they can be classified and grouped; and so can weather maps. This should have been added.

Mr. Lempfert writes in an easy and familiar way of the work of the forecasters during the Great War. The book begins with a study of a certain anticyclone which persisted from September 5 to 14, 1915. Probably because the author is a forecaster he realizes what most writers of meteorological books have failed to comprehend, namely, that the anticyclone is the dominating factor in determining weather sequences. Apparently it controls the path and speed of the "lows" following it.

There are different types of "highs," and, unfortunately, the Weather Map gives little indication of such difference. There are cloudless anticyclones and clouded anticyclones if the latter word may be allowed. In the cloudless type in summer, high temperatures prevail; and, as the condition is one of stagnation, there is an accumulation of heat in the lower levels and so a hot spell lasting several days—a period when the forecaster can promise no relief. In the same type during winter, because of free radiation, extremely low temperature may occur. In the other type of "high" the temperature amplitudes are limited, and conditions are more uniform. At such times surface readings of pressure and temperature may mislead the forecaster.

A good illustration of a "cyclone," "depression," or "low" is that of February 17, 1915; and the discussion loses nothing of interest when the author drives home the fact that two German airships were wrecked on the coast of Denmark through stress of weather. This happened, our author states plainly, because the German forecasters were unable to locate the center of the depression—which was over Ireland. With commendable frankness, however, he states that British forecasters, lacking definite information, would have been unable to do any better than their German colleagues. The reviewer, who happens to have had some experience in Europe during the war in connection with forecasting, ventures the opinion that if the matter could be investigated closely it would appear that delay in transmission of weather reports hampered the forecasters, for even in France it was no unusual thing to receive morning reports late in the afternoon.

The map for October 19, 1917, the date of the great Zeppelin raid, is given and is a good example of an anticyclonic wedge. An unexpected strong current from the north carried the air fleet (13 in number) out of course, on the return, and led ultimately to the loss of 8 airships—the flower of Germany's air fleet.

The chapters on Temperature and Clouds are brief but to the point. Only eight illustrations of cloud types are given. On page 47 the place of the highest sounding balloon record is given as Padua. We understand the record was made at Pavia.

In the chapter on the Stratosphere, on page 144, it is stated that the lowest recorded temperature "at ground level is 213a, observed on the great ice barrier of the Ross Sea on July 6th, 1911, by Captain Scott's expedition." We believe that there is an authentic reading of 205a (751 Kelvingrads,—68° C.,—90° F.) at Verkhoyansk, February 5–7, 1891. This is erroneously given several degrees lower in Woeikof's "Meteorologie," 1910. In this chapter no mention is made of Professor Humphreys' explanation of the cause of the stratosphere: although proper mention is made of Gold's work on what may be called the radiation balance sheet for different levels of the atmosphere.

Other chapters deal with the thermal structure of the atmosphere, origin of changes of pressure, tropical storms, and the chemical composition of the atmosphere.

ALEXANDER MCADIE

## CLIMATOLOGICAL ATLAS OF GERMANY

G. HELLMANN AND OTHERS. **Klima-Atlas von Deutschland.** 63 pp. of maps, 40 pp. of text. Dietrich Reimer (Ernst Vohsen), Berlin, 1921. $7.00 bound. 12 x 14 inches.

The Prussian Meteorological Institute, with an enviable record of effective service to meteorology behind it, has added another important volume to its already long list of valuable publications. In the new "Klima-Atlas" of Germany, we have presented all the

essential facts concerning the climates of Germany (with the area it had before the war), both in cartographic and in tabular form. That the work was done under Hellmann is a sufficient guarantee of its accuracy. To him and to his co-workers, Professors G. von Elsner and H. Henze and Dr. K. Knoch, climatologists are under a real debt.

The Atlas includes 87 colored charts and 16 tables of climatic data. The scale of the maps is partly 1 : 4,250,000, partly 1 : 8,500,000, and, in the case of the monthly rainfall maps, 1 : 1,250,000, in order that the local peculiarities of the distribution of precipitation may be clearly brought out. The basic period is in general 30 years, 1881–1910, except in the case of rainfall, where it is 20 years (1893–1912). These periods were selected because they include the largest series of reliable homogeneous observations. All records covering shorter periods than these were reduced to the basic periods.

The charts show the annual and monthly isotherms, isobars and average wind directions, and vapor pressures, all at sea level; also the relative humidity, cloudiness, and precipitation at the earth's surface. There are, in addition, single charts of the annual range of the monthly mean temperatures, the mean annual number of days with rainfall of at least 0.1 millimeter; of days with snowfall (melted) of at least 0.1 millimeter; and of the month of greatest rainfall; least rainfall; greatest and smallest number of rainy days (0.1 millimeter and over); average annual number of clear days and average annual number of cloudy days. The rainfall maps are especially instructive because of the light they throw on the local topographic effects, which are well marked in the south and west, while the distribution of rainfall over the great lowlands of the north and east is fairly uniform. Further, the general warm-season, "continental" rainfall maximum is clearly seen on comparing the winter with the summer maps.

Many comments suggest themselves to the reviewer, but to begin with details would inevitably lead to a lengthy discussion. Three points only will be noted. The first is the interesting fact that the northern base of the Harz Mountains as well as of the Alps shows, in several months and for the year, local favorable temperature conditions which are doubtless due to the *föhn* wind. The second comment concerns the absence of any charts of actual (surface) temperatures. While sea-level isotherms are indispensable in any broad studies of the controls of climate by land and water, it is the actual temperatures, not reduced, that are dominating factors in plant and animal life. As time goes on and as more complete temperature observations become available, isothermal charts showing actual temperatures will inevitably be more and more often used. It would seem that in the case of Germany, with a fairly fine-meshed net of meteorological stations, charts showing the actual temperatures might even now be drawn with a very reasonable degree of accuracy and without the necessity of too much interpolation. The third comment concerns a rather conspicuous absence of sunshine maps in the Atlas. The explanation, as is to be expected, is the lack of sufficient data for constructing good maps of this sort.

Those who have kept in touch with recent publications on the climatology of Germany will see in the new Atlas the completion, in final form, of numerous studies by Hellmann which have appeared during the past two decades. Mention may here be made of a considerable series of small rainfall maps of separate parts of Germany, with brief discussion, and a general rainfall map of the country as a whole, the first edition of which bears the date 1906 and the second 1919 (Dietrich Reimer, Berlin). There are two other recent papers on rainfall ("Neue Untersuchungen über die Regenverhältnisse von Deutschland," Erste Mitteilung, *Sitzungsber. Königl. Preuss. Akad. der Wiss.*, Berlin, 1919, Part I, pp. 417–432; Zweite Mitteilung, *ibid.*, 1921, pp. 246–257). The second of these papers shows lines of equal annual numbers of days with snowfall. Hellmann has also recently published a paper on the isotherms of Germany ("Die Isothermen von Deutschland," *ibid.*, 1920, pp. 369–376; Pls. 2) and on cloudiness in Germany ("Die Nebel in Deutschland," *ibid.*, 1921, pp. 900–919).

R. DEC. WARD

### IRRIGATION AS AN INSTITUTION IN THE WEST

GEORGE THOMAS. **The Development of Institutions under Irrigation, with Special Reference to Early Utah Conditions.** vii and 293 pp.; map, ill., index. (The Rural Science Ser., L. H. Bailey, edit.) The Macmillan Co., New York, 1920. $2.75. 7½ x 5 inches.

Dr. Thomas has made a valuable contribution to the literature of irrigation in the United States. The first attempts in this country to develop irrigation co-operatively

were made in Utah seventy-five years ago. From this beginning the evolution of the legal and social institutions of irrigation has been rapid, and a wide diversity of results has been achieved.

This evolution, as it has gone on in Utah, has been conscientiously reviewed in the present book. The story is told in simple language and illustrated with bits of early history that serve their purpose well.

One of the best features of the book is the account of how the doctrine of riparian rights, which comes to us from English common law, has been modified by the need of validating the right to appropriate water for beneficial use. This account is simply stated and well illustrated by specific cases.

The author holds strong views as to what is sound irrigation law and what is not. He believes that appropriated water should be appurtenant to definite tracts of land and that in the arid states the actual ownership of the water should remain with the public, that is with the state.

It is clear that seventy-five years has not been long enough, in Utah at least, to work out and put into practice a satisfactory body of irrigation laws and adequate machinery for their administration.

It is unfortunate the work is marred by lack of editing. This is shown in the needless repetition of some of the cases cited as well as by a certain monotony of treatment.

C. S. SCOFIELD

## A REFERENCE WORK ON CENTRAL AMERICA

KARL SAPPER. **Mittelamerika.** 124 pp.; map, bibliogr., index. (Auslandswegweiser, herausg. von dem Hamburgischen Welt-Wirtschafts-Arciv und dem Ibero-amerikanischen Inst., Vol. 5.) L. Friederichsen & Co., Hamburg, 1921. 7½ x 5½ inches.

A work by Sapper on Central America is always an event of geographic importance because of his devotion to the geography of this region and his many contributions to it. The present work is important not because of any contribution to geographical theory but for its systematic treatment of the geographic and economic elements of Central America. It is a standard reference book on the subject, with up-to-date statistics and statistical analyses and explanations, together with an excellent map in color, on the scale 1 : 10,000,000. Throughout the book there is attention to the outstanding geographical controls, and this makes the organization of the material particularly valuable. The strong regional contrast between the Atlantic and the Pacific slopes of Central America is brought out and forms, in fact, a dominant note in the life of the region from the earliest settlement down to the present time.

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